(INDEX TO VOL. 138)

THE

CHEMICAL NEWS

AND

JOURNAL OF INDUSTRIAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE,"

A Journal of Theoretical and Practical Chemistry and Physics,

IN THEIR APPLICATION TO

ENGINEERING AND MANUFACTURES

INDEX TO

VOLUME CXXXVIII., JANUARY TO JUNE, 1929.

PRICE, SEPARATELY, 6D.

PUBLISHED AT THE OFFICE, MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

AND SOLD BY ALL BOOKSELLERS.

LONDON.
PRINTED BY REA, WALKER & INCHBOULD, LTD.,
224, Blackfriars Road, S.E.1.

exist as individuals is patent. In all cases crystalline matter is not less individualised than the simplest forms of ultra-microscopic life that are now known.

Another distinction between crystals and organisms is found in the differentiation which the latter exhibit. The organic individual is not homogeneous. The various parts form definite organs, which often differ amongst themselves. But amongst different living things there is much variation with regard to this differentiation, and in some of the simplest forms there is, as we shall see, no differentiation of parts visible, even under the highest powers of the microscope. Ultra-microscopically, all colloidal matter is differentiated, for it consists of numerous very minute particles, solid or liquid, suspended in a different medium, and the visible differentiation that sometimes occurs in colloid substances, and is so characteristic of the living cell, is but the further elaboration of this differentiating tendency. On the other hand crystalline matter is essentially homogeneous, but occasionally beginnings of a differentiation may be traced. There are thus crystals with a difference in constituents in different parts, whilst sometimes visible modifications have been observed at certain points and areas, as in the so-called "Petro-cells" with their "nuclei."

Just as different forms of crystals have each their own special chemical constitution[1], so recent work has shown that the different species of plants and animals possess different kinds of living protoplasm. It is true that the latter cannot be directly studied, but as the latter cannot be conceived of as existing without the products it gives rise to, one is justified in judging its variations by the variety of the products. Everyone knows that different plants differ in the demicinal principles which they produce. Even products, like starch, that are produced by many different plants, are not quite the same in different species. Thus Reichert, working on the starches of a large number of plants (300, representing 105 genera and 34 families) discovered that they form a remarkable stereoisometric series with slight differences in the crystalline form, solubility, reaction to iodine and other properties. The same investigator found analogous differences in the hæmoglobins from the blood of numerous different species of animals (107 species, mostly mammals, but including fishes, amphibia, reptiles and birds)[2]. Bacteria and Fungi are particularly variable in their chemical characteristics and most of the systems of classification of the former group of organisms are based on differences in the chemical characters of the different species.

If no distinction can be made between crystals and organisms with regard to the relation of form to chemical constitution, is it possible that the form itself will show a fundamental difference? Symmetry is an essential feature of crystals[3]. They have a definite mathematical figure and in this it may be claimed that they differ from living organisms. No mathematical figure exists in nature, geometry is a product of the human mind. Not only are parts missing but visible distortion from the ideal form can actually be measured with the goniometer.

All organisms vary; even individuals of the same species are not alike. So it is with crystals. Tutton[4] has observed the variation of a few seconds of arc in the angles of crystals of the same substance, whilst those of allied substances show differences of a few minutes of arc.

The crystal is a colonial individual, as most plants are. It can be divided into pieces which are equivalent to one another and to the whole, just as the plant can be segmented into various shoots which are homologous with ont another and repeat the whole plant on a small scale. Closely allied substances, which, besides generally having a similar chemical composition, have a very similar crystalline form are said to be isomorphous, *i.e.*, crystals composed of molecules of both the materials in question. They can also form so-called overgrowths, in which a layer of the one substance is deposited over a core of the other. It has now been known for some years that certain closely related organisms, *i.e.*, those that a similar structure and a similar chemical composition, can form graft-hybrids. The latter, which are chiefly found to occur in plants, although they have been described in some animals, are not formed by the fertilisation of one form by another, as in ordinary crossing, which might involve the chemical combination of two different kinds

[1] The same form may sometimes be shown by unrelated substances in some cases, just as unrelated organisms not infrequently develop the same type of symmetry.

[2] Carnegie Inst. Publns. No. 116.

[3] Symmethy is also an essential feature of organisms, but is not always so clearly visible as in crystals. But note the symmetrical forms of Radiolaria and Diatoms, and also of the leaves of plants.

of protoplasm and the production of a new type, but purely by the coming together of cells of the two species during grafting and the formation of a product, *i.e.*, the graft-hybrid, which contains side by side with one another but without mingling elements derived from the two parents. And in some cases the graft-hybrid consists of a skin of one species surrounding a core of the other. The parallel between such graft-hybrids and overgrowth crystals is a complete one.

In spite of many assertions to the contrary, growth and reproduction of the crystal is essentially the same as in the living organism. One may distinguish between internal and external growth. The former takes place by tntus-susception, *i.e.*, the intercalation of molecules between those that are already present. External growth is by accretion, *i.e.*, the adding on of molecules outside the region in which they were originally present. Both these processes of growth take place in living cells. In crystals only growth by accretion is found. But internal growth is not absolutely confined to the living cell. For example, the colloidal membranes in Traube's famous artificial growing cells[5] increase by a process of intussusception. Reproduction of crystals, like that of the lowest forms of life, is merely a form of growth, accompanied by breaking.

But apparently unlike organisms, crystals sometimes originate *de novo*. Living things arise from the egg, which is itself a product of a pre-existing organism. "*Omne vivum ex vivo*" appears to be an axiom of biology. Whether it is really always true has been discussed by writers on Spontaneous Generation. But crystals arise from pre-existing crystals in the majority of cases. Even when an apparently pure homogeneous solution is crystallised, it is probable that small particles of the solid substance (*i.e.*, very minute crystals) are present and act as centres around which the visible crystalline masses are deposited. Many saturated solutions, in fact, will not crystallise, until small crystals, of the same substance as that which is held in solution, are introduced. This process is called "inoculation." Crystals of any substance are best formed by inoculation with crystals of the same substance, but in many cases it is sufficient if a closely allied substance is introduced. Thus m-cresol may be crystallised at 180° C. by inoculation with phenol (Stadel). Similarly dibromide of propylidene acetic acid refuses to crystallise, but may be induced to do so by a crystal of dibromide of ethylidene propionic acid (Otto)[6]. These phenomena may be compared with the changes which result when a seed has to be built up with nourishment from a new source, or when a young animal is fed on a kind of food unknown to its parent. In such cases the form of the offspring is somewhat different from that of the parent, owing to the new conditions under which it is reared. Of course a seed placed under totally different nutritive conditions would not develop at all, just as a crystal placed in a solution of an altogether unrelated substance, would produce no crystal growth.

The living body is in constant activity. Respiration and digestion are only two examples of a continuous series of chemical changes that go on within. Life is a flame. The comparison with combustion is not a metaphorical one. But this general metabolic activity is not always equally active. In plants it is not so great as in animals[7], in sleeping not so pronounced as in waking. And in some tissues, such as the wood of plants and the bones of animals, it almost reaches zero. Hence in the mineral kingdom, representing a lower stage than that of the plant, the metabolic processes may be considered to go on at a very low rate or even become extinguished, without any violence being done to the general view of continuity between th living and so-called non-living.

[4] *Journ. Chem. Soc.* (Trans.) 63, 1898.
[5] For a description of these and many other experiments of the same kind, see S. Leduc. *The Mechanism of Life*. English Trans. London. 1911.
[6] Groth. *Chemical Crystallography*. Engl. Trans. London. 1906.
[7] As Aristotle said: "Plants are animate compared with minerals, and inanimate compared with animals."

ROYAL SOCIETY OF BRITISH SCULPTORS.

The gold medal of the Royal Society of British Sculptors "for distinguished services to sculpture" has been awarded to Mr. W. Reynolds-Stephens. The medal was founded in 1928, and is the highest distinction which British sculptors can award. The previous recipients have been the late Sir Hamo Thornycroft and Mr. Alfred Gilbert.

THE DIFFICULTIES OF MODERN PHYSICS.

By Dr. W. Tombrock.

A well-known German scientific investigator whom I sent a series of reprints from my work in this paper kindly answered by sending a couple of articles in which the famous physicists, Prof. Planck and Prof. Schrödinger, are reported giving their opinion about the curious aspects that light nowadays presents to its devoted investigators.

From Max Planck the following has been reported by Kurt Joël :—

" Als der Däne Niels Bohr sein Atommodell schuf und die negativen Electronen um den positiven Atomkern — wie die Planeten um die Sonne— kreisen liess, hoffte man, dass die Physik sich auf dem geraden Wege zu ihren ' idealen Endziel ' befände. Aber es ist ganz anders gekommen. *Die Natur des Electrons wird immer problematischer.* So verbäld sich zum Beispiel ein mit einer bestimmten Geschwindigkeit sich bewegendes freies Electron gar nicht wie ein einzelnes fleigendes Projektil, sondern viel eher wie eine über dem ganzen unendlichen Raum gleichmässig ausgebreitete Welle von bestimmter Periode..."

From E. Schrödinger we cite : (Vortrag in der Festsitzung der Heinrich-Hertz-Gesellschaft reported by K. J.)

" Seit zwei Jahrzehnten, mehren sich die Beweise, dass das Licht *die einander scheinbar widersprechenden Eigenschaften einer Wellen- and einer Korpuskelstrahlung besitzt...*

1925 hatte—und das ist weider eine Schritt weiter—*de Broglie* rein spekulatif die Vermutung ausgresprochen, dass ein *fliegendes Electron von einer Wellenstrahlung begleitet sei...* Man fulhte : Diese *Electronenbahnen* (der Rutherford-Bohr sche Atomvorstellung) sind nur *Symbole*, es gibt sie in Wirklichkeit nicht... Dieser Erfolg ermutigte einige Forscher—Davisson and Genner sowie den jungen Thompson—ganz eigenartigen Versuchsanordnungen aufzustellen (einige Jahre vorher hätte man sie dafür, so bemerkte Schrödinger, einer phychiatrischen Klinik zur Beobachtung ihres Geisteszustandes überwiesen) Sie hatten aber vollen Erfolg. Sie konnten *mit Kathodenstrahlen- einige Interferenz- und Beugungsversuche anstellen...* (mit vollem Erfolge ?)... Also gibt es anscheinend überhaupt bloss Wellen, sowohl das Licht als auch die früheren Korpuskularstrahlen (Kathodenstrahlen !) *erweisen sich als Wellenstrahlen. Es gibt also überhaupt keine korpuskeln (!)*" (Schrödinger.)

To me the logical aspect of this learned reasoning appears as curious *as the results* of these investigations. First, Prof. Schrödinger remarks that light has been proved to be *of a twofold* character, afterwards when this twofold character has been also proved for cathode rays, he says quietly : There are no corpuscular rays but only undulations. To me this seems to be *no unprejudiced* acknowledging of experimental results, but an unvoluntarily recurrence to the old standpoint—the historical putting of the problem—that light must be *emission or undulation*, whereas the experimental results point decidedly to : emission *and* undulation. To me it is not, neither has it ever been, a logical postulate that emission should exclude a disturbance in the ether. On the contrary ,emission *must* give rise to disturbances in the ether, light is primarily emission and secondarily disturbance in the ether atmosphere.

To this conclusion we come by a very simple reasoning, by assuming matter to be that which moves, and having this fundamental property that two parts of it cannot at the same time occupy the same place (collision !). Therefore—as we have repeatedly pointed out—ether *must* be discontinuous. The atom becomes a relatively stable configuration of cyclonical motion in the ether atmosphere. Centres of motion are the strongly rotating protons which build up the atoms, electrons, or ether particles, moving between and around them. Ether particles are absorbed by and rejected from these cyclones, their forms of motion being altered thereby, and this causing the phenomenon of gravitation.

Now the emitted rays must build streams of rotating electrons or ether particles with considerable translational velocity. In connection with the surrounding ether particles we get the image of a very quickly revolving screw. Under certain circumstances the rays can evoke the sensation of light or sight. And it depends only on the experimental conditions whether we observe its emissional (or corpuscular) aspect or the phenomena we are used to explain by ether disturbances (or undulation).

The suggestion lies directly at hand that these revolving screws of ultimate material particles can destroy each other by scattering... which we assume to understand the phenomena of interference and diffraction. An analogue for undulation and wavelength is here also easily to be found... but we will not go into further details here, later on, when we will try to test this fundamental and most simple conception of matter to the principal phenomena of light, we will in due course come to that.

But we *must* emphasise that the twofold character of light can be quite easily and fundamentally explained by a simple mechanism which directly is brought about by a logical consideration of the two head properties of matter, *viz.* : its motion and its impenetrability.

Bergen op Zoom,
Holland.
December 6, 1928.

PAPER PULP AND CELLULOSE FROM THE EUCALYPTS BY THE SULPHITE PROCESS.

By L. R. BENJAMIN AND
J. L. SOMERVILLE, B.Sc.

(*Continued from page 407, Vol. 137.*)

ANALYTICAL METHODS.

Liquor Analysis.—The cooking liquor was prepared, as already explained, in an amount sufficient for a single charge at a time, by passing sulphur dioxide into a measured quantity of water containing an amount of lime previously weighed. The total sulphur dioxide content of the liquor was determined by the usual analytical method, using a standard iodine solution. When sulphur dioxide is dissolved in a suspension of lime, as in making the liquor charge above, the volume increases. The amount of this increase for the various amounts of sulphur dioxide dissolved was determined beforehand, thus enabling a correction to be applied to the lime content of the liquor as calculated from the weight of lime and the volume of water used. The "combined SO_2" so called, is the amount of sulphur dioxide that would be in combination with all the lime as the normal sulphite, $CaSO_3$, and was calculated from the lime content. The "free SO_2" is the difference between the "combined" and the total SO_2. The "excess SO_2" is the difference between the total SO_2 and the amount actually combined with the lime forming the bisulphite $Ca(HSO_3)_2$.

In the spent liquors examined, the "total SO_2" was determined in the same way as in the cooking liquor. The "reversible SO_2," defined by Klason as that held in weak combination with the lignosulphonic acids of the spent liquor, and not titratable directly with iodine solution, but only after the action of excess sodium hydroxide for a short time, was determined in the same sample. After the titration for total SO_2, the liquid is made alkaline and allowed to stand for half an hour, when it is acidified with hydrochloric acid and again titrated with iodine solution, the second titration giving the "reversible SO_2." The sugars present in the spent liquor were determined by the gravimetric cupric-reduction method as given by Schwalbe and Sieber.

Pulp Analysis. The following analyses were made on each unbleached pulp :—lignin, cellulose, α-cellulose, and ash ; and on those bleached pulps that were analysed—α-cellulose and ash. The cellulose, α-cellulose, and lignin were all determined free of ash.

The slush pulp to be used for analysis was first filtered on a Buchner funnel, washed once with alcohol, then removed and allowed to dry in the air. The cake of pulp thus obtained was softer because of the use of alcohol, and this, especially with pulps that were rather wet in the unbeaten state, facilitated the subsequent process of teasing with a wire brush.

The open-textured dry pulp obtained by teasing was stored in air-tight bottles for one or two days to ensure the attainment of uniformity of moisture content, which was then determined by weighing a 1-gram sample after drying at 105° C. for a period of six hours and again after a further drying period of 16 hours (*i.e.*, overnight). The weight usually, but not invariably, fell slightly during the second drying period, and the moisture content was calculated from the lowest weight, the mean of two concordant results being taken in each case. Air-dry pulp taken from the bottle was used in all the subsequent analyses. The constituent determined was expressed as a percentage of the oven-dry pulp equivalent to the air-dry sample taken.

Lignin.—The lignin in the pulp was determined by the action of concentrated (41 per cent.) hydrochloric acid, according to the method of Heuser and Wenzl. The cellulose and hemicelluloses of the pulp are hydrolysed and dissolved by 41 per cent. hydrochloric acid, leaving the lignin as an insoluble residue, and, after filtration, the lignin is rendered more easy-filtering by boiling the mixture for ten minutes, or more, if necessary. The main part of the lignin is allowed to settle, and the decanted liquor filtered by the aid of a common automatic filtering device, through a Gooch crucible fitted with an asbesos mat. The remainder of the lignin is also filtered and the whole washed free from hydrochloric acid with cold water. The lignin is dried in the same manner as the pulp for the moisture sample, is weighed, then burnt away in a muffle furnace, and the amount of lignin free of ash determined by difference.

Ash.—The ash in the pulp was determined in the usual way, by incinerating 1 to 2 gms. of pulp in a platinum crucible.

Cellulose.—The method that has been adopted in this laboratory for cellulose determination is based on the use of freshly prepared chlorine water ,in which the material is stirred; whereas in the Cross and Bevan method, some modification of which is generally used by cellulose technologists, pulp or wood dust is treated while still moist with chlorine gas. The subsequent *operation are the same in both methods;* the compound formed between the lignin in the material and the chlorine is dissolved in hot sodium sulphite solution.

In the analysis of an unbleached pulp, 2 gms. are weighed out into a filtering crucible and washed with hot water to drive the air out of the fibre in preparation for the next process, that of chlorination. The chlorine water is prepared by passing the gas under some pressure through a fine jet in a glass tube into cold water. In this way a saturated solution is easily prepared in two or three minutes. The solution obtained is titrated and diluted to a strength of 6 gms. of chlorine per litre. The pulp is transferred to a beaker, and mixed for firteen minutes with 100 ccs. of chlorine water of this strength, and then filtered and washed three times in the crucible with cold water. The pulp is then washed into a beaker with 300 ccs. of a 5 per cent. solution of sodium sulphite crystals. The beaker and its contents are placed in a boiling water bath for half an hour, and then the pulp is again filtered and wasbed with hot water. With most pulps the lignin is not yet completely removed, and the whole of these operations must be repeated until no colour is developed upon the addition of sulphite solution to the chlorinated pulp. The pulp is, finally, very thoroughly washed with a litre or more of hot water and then once with alcohol. It is dried under the conditions given above for the moisture sample.

This method is not shorter, but is more convenient than the Cross and Bevan method using the chlorine as gas. In both methods, it is necessary to avoid using the chlorine as gas. In both methods, it is necessary to avoid exposing the cellulose to the action of the chlorine, either as a gas or in solution, when the lignin has been almost completely removed, because in this condition the cellulose is easily degraded chemically, as is shown by a rise in its copper number and a fall in the *α-cellulose content.* On the other hand, it is known that if lignin is present, chlorine water does not markedly exert these oxidising effects on the cellulose.

The chlorine water method was also used in determining the cellulose content of woods. The sample for analysis was obtained from sawdust, the part used being that which would pass through a 60-mesh and be retained on a 100-mesh I.M.M. sieve. The moisture content was determined as in the pulps. The sample for the cellulose determination was first extracted in a Soxhlet apparatus by the constant boiling point mixture of benzene and alcohol. The eucalypt woods examined usually required three periods of chlorination of fifteen minutes each, but in some instances ten minutes was sufficient for the last period.

The quality of the cellulose with respect to its α-cellulose content is thus assured, and it was of less importance that the cellulose content of the pulp or wood by the chlorine water method should be the same as given by the chlorine gas method. The difference between the results given by the two methods was, nevertheless, small, since a direct comparison on *Pinue insignis* wood resulted in 57.4 per cent. and 57.1 per cent. respectively. This cellulose content is in actual fact an elusive figure, since " wood cellulose " is a very vague term, and in the consideration of pulp and pulping problems, is best defined by the method of analysis used. The cellulose content of bleached pulps is nearly 100 per cent., but its exact determination is difficult, and because of the absence of lignin the chlorine methods are inapplicable.

The bleached pulps were therefore, considered from the ponit of view of the quality as celluose, for which purpose the α-cellulose and ash contents were obtained.

α-Cellulose.—This term is applied to the portion of the cellulose that is insoluble in a 17.5 per cent. caustic soda solution in the cold. A further portion of the residue after washing is, in general, removed by a second treatment with the alkaline solution, but for most purposes the proportion left after the first treatment is taken as significant. The details of the procedure, however, need to be standardised to enable independent observers to obtain comparable results.

The α-cellulose content is one of the accepted criteria of the purity of a pulp, and in particular of its usefulness as a raw material for the manufacture of " rayon " or viscose silk. It is also of importance in the interpretaton of cooking data, for it is sensibly affected by alterations in the chemical conditions prevailing during the digestion of the wood.

It was necessary in this work to modify the more widely accepted methods of determining α-cellulose content since they are designed for application to commercial bleached pulps, and, there being no reason to limit the quantity taken, 3 to 10 gms. are used, according to the particular method employed. On the other hand, when it is desired to determine the α-cellulose in the cellulose obtained from a sample of pulp or wood by the chlorine method of analysis, the size of the sample for the α-cellulose is necessarily much smaller.

The cellulose, dried at 105° C., is first allowed to absorb moisture from the air by standing for a day; it is then removed from the crucible and moistened with 12 ccs. of 17.5 per cent. sodium hydroxide solution (by weight) in a 150 cc. beaker, which is placed in a water bath at 16.5 deg. C. The mass is kneaded at intervals with a glass rod, and after half an hour is diluted with 50 ccs. of 5 per cent. sodium hydroxide, which brings the mixture to a strength of obout 8 per cent. sodium hydroxide. The mixture is filtered at this stage through the same crucible as that in which the cellulose was handled. The pulp is then washed with 50 ccs. of 8 per cent. sodium hydroxide, then with water till it is free of alkali, then with 10 per cent. acetic acid, and then very roughly with hot water. The first washing with water has to be done carefully, because if water is incautiously added to the pulp while moist with 8 per cent. sodium hydroxide solution, hard lumps are formed which resist subsequent washing. The best procedure is to remove the bulk of the pulp from the crucible into a beaker and slowly dilute it with constant stirring and then filter it. When this has been done three or four times the pulp is nearly free from alkali, and is not liable to form into lumps. The last washing with hot water is carried out in a similar manner. After the removal, dilution and refiltering have all been done six times, using 100 cc. of water each time, the pulp is washed once with alcohol, dried at 105° C., as described above, and weighed. The accuracy of the result for α-cellulose is affected considerably by the thoroughness with which the cellulose is washed and by the conditions under which it is dried, even though the effect of these factors on the cellulose during drying lowers the α-cellulose content, but it was also found in the present investigation that even with the most thorough washing the concordance between α-cellulose results could be improved by washing the cellulose with alcohol before drying it in the oven. It is also known that cellulose under the influence of heat and moisture is, by atmospheric oxidation, partly converted into oxycellulose, which substance is soluble in 17.5 per cent. sodium hydroxide solution, and in this fact lies the explanation of improved α-cellulose results, since the alcohol washing increases the initial rate of drying of the cellulose in the oven.

The above method was also used to determine the α-cellulose contents of the unbleached pulps and of the woods.

The crucibles used for the cellulose and α-cellulose determinations on the pulps were ordinary Gooch crucibles with a thick mat of asbestos at the bottom. In comparison with other crucibles used, such as those of alundum or those with fritted porcelain or glass bottoms, these suffer from the disadvantage that, until experience is gained, the asbestos mat is liable to shift and pass particles of pulp. This disadvantage, however, is outweighed by the advantage that when the asbestos becomes clogged by fine particles, and filters slowly, the top layer of the asbestos can be scraped aside, thus restoring the rapid rate of filtering.

For the analysis of wood meal, however, the fritted glass filtering crucibles were preferred, because after the first or second chlorination the original particles have separated somewhat, producing a relatively large quantity of very fine material, some of which would be lost by the asbestos crucible, but is retained by the glass. Although the filtering with the latter becomes extremely slow, this is tolerated because of the increased accuracy of the result.

The α-cellulose after drying is incinerated in the crucible, the ash-free weight being obtained by difference. Experience has shown that it is sufficiently accurate to assume that the ash in the cellulose is the same as that in the α-cellulose so that the ash-free weight of cellulose is also obtained from the final weighing of the crucible after ashing.

(To be continued.)

HIGHWAYS OF TO-MORROW.

By Major H. O. D. Seagrave.
(The Racing Motorist.)

These are busy times for the map-makers. A pre-war atlas of Europe is, of course, useless to-day except as a curio, so complete has been the rearrangement of national frontiers; and here in this favoured island a revolution no less disastrous to the products of former cartographers is in progress, taking shape in the transformation of our road system.

GROWTH OF MOTOR TRAFFIC.

Every few months we hear of the opening of some new great artery, by-pass or circular road. The work of their construction goes on apace, urged by the pressure of ever-growing motor transport. In the first two months of 1928, licences were issued for 1,463,452 mechanically propelled behicles—one for every thirty people in Great Britain. Now, at the end of the year the total approaches the two million mark. The weight of heavy goods traffic on eight roads running out from Liverpool was found by a test census to have risen from a pre-war figure of 884,000 tons to a present total of 9,826,000 tons per day. On the Gloucester-Bristol road the traffic in the same period was increased nearly twenty-fold, while on the London-Brighton road it is increasing by 28 per cent. per annum. Every week-end an unending procession of cars travelling at railway speed crowds the main arteries from each large city. We have not yet approached the car population of the United States, where there is a motor to every five persons. We are limited by our road shortage. The States have 150,000 miles of concrete roads. All the highways of England and Wales put together, including every lane and by-road, hardly surpass this figure, and only 19,000 miles of them are Class 1 roads, of which not more than half have as yet been properly constructed to bear the modern traffic which runs over them. Hardly more than 10 per cent. of the remaining 130,000 miles of roadways have been put into up-to-date condition.

The solution of the problem is becoming increasingly clear. It is the concrete road. As compared with other forms of road material, concrete has a whole array of immense advantages. In the first place, its ingredients are all home products, for England is unsurpassed in the making of cements, while materials for the aggregatae are to he found in nearly every part of the country.

£50,000,000 ANNUAL FIRE LOSS.

A Conference arranged by the Association of Liquid Chemical Fire Extinguisher Manufacturers took place on Tuesday, December 4, at the Institution of Mechanical Engineers. The chair was taken by Mr. A. E. Wiseman (The Pyrene Company, Ltd.), who was supported by Mr. S. G. Gamble, F.S.I., A.M.I.C.E., and by the following members of the Council of the Association: Messrs. J. W. Blackman (The Valour Company, Ltd.), A. W. Cook (Minimax, Ltd.), Leonard Jones (Samuel Jones & Co., Ltd.), W. E. Ashley (J. Blakeborough & Sons, Ltd.), and C. T. Parfitt (Moneys Patents, Ltd.).

Mr. A. E. Wiseman (chairman), in opening the Conference, welcomed a large number of representatives from fire brigades, municipal authorities, important manufacturing concerns, and others interested in practical fire protection. The chairman stated that this was the first meeting of its kind that had ever been held in this country. The Council of his Association felt that nothing but good could come from the makers of fire appliances coming face to face with the actual users with a view to a mutual understanding of their respective problems. During the first nine months of this year, the fire losses in this country amounted to about £8,000,000. This represented an increase of about £1,000,000 over the first nine months of 1926 and nearly £3,000,000 during the similar period in 1927. The manufacturers of fire appliances are doing a vast amount of researcb work in an endeavour to supply equipment to combat this menace to the prosperity of industry, and that the Conference had been organised with a view to co-operative action between themselves and the actual users of their appliances.

Mr. S. G. Gamble, who, for 26 years was second in command of the London Fire Brigade, said:

"It is a challenging fact that insured property to the estimated value of forty to fifty million pounds stering is destroyed by fire throughout the world every year. Despite this fact, it still has to be admitted that comparatively little attention is being paid in this country, which suffers about one-fifth of the wirld's fire loss, to the subject of fire prevention and fire protection.

There are those who argue that the fact that property is insured renders the matter of fire protection of little account. Such argument entirely overlooks the great loss to the community caused by a serious fire, and that in the long run, either directly or indirectly, the community pays.

To the public generally, as well as to those responsible for the maintenance of extensive business premises, the provision of efficient fire protection is a matter of first-class importance. In every scheme of fire protection hand chemical fire extinguishers have their recognised place. The efficiency, ease of operation and handiness of these extinguishers is universally admitted. There are three distinct types of hand extinguishers.

They are, the soda and acid type—for dealing with fires of a general nature—foam or froth type, specially suitable for fires involving petrol, oil, etc., in bulk—and the carbon tetra choride type, for petrol and oil and fires where electricity is involved.

Extinguishers of either type properly charged in the first instance and given the little care and attention they require, can be relied upon to do their work at any time."

Mr. Gamble gave some very interesting hints on the proper distribution of extinguishers, and strongly recommended that the workers in a building should be instructed in the use of fire appliances, and that occasional opportunity should be afforded when the hand extinguishers could be operated on an improvised fire.

A very animated and instructive discussion of a technical nature followed. The interest displayed was so great that Mr. Wiseman stated in response to the desire expressed by many of those present, that an endeavour would be made to organise further conferences to discuss other aspects of the problem of fire protection and fire prevention.

MODERN GLASS MANUFACTURE.

In a paper on "Modern Glass," read before the Royal Institute of British Architects on the evening of December 17, Mr. Basil Ionides said that France had been the leader in the more modern forms of glass work, though really there was practically no work that could not be done in this country. It was expensive to make the moulds for cast glass, and so there had not been much enterprise in this line in England, though on the Continent many delightful figures and decorations had been done by manufacturers like Lalique, Damon, and others, but these could be imported and use well. All sand-blasting, etching, aciding, and engraving, however, could be as well done here as anywhere else, and never had glass been better, more varied, or easier to get than now.

Mr. Iionides described many kinds of glass now manufactured, and in reference to vita glass said that no doubt the day would come when all windows would be fitted with it. It allowed the ultra-violet rays through in greater quantity than other glass, and even on dull days the light coming from otuside had a beneficial effect on humanity, plants, and, he feared, insects. He was told that in greenhouses, the pests did likewise, and that future generations of spiders and flies might be enormous.

SIR OLIVER LODGE ON ARTIFICIAL SUNLIGHT AND GOOD HEALTH.

Sir Oliver Lodge presided on December 12 at a lecture by Mr. G. G. Blake, at the Royal Society of Arts, on "Applications of Electricity to Medical Practice."

Referring to the various forms of ultra-violet apparatus at present in use for actinotherapy (artificial sunlight treatment), Mr. Blake said he had seen some truly wonderful cures of children suffering from tuberculosis, rickets, anæmia, etc. He considered the results so startling that if only the beneficial effects of occasional general treatment by ultra-violet rays could be made more widely known, he believed in a few years every home where an electricity supply was available would have a lamp installed and artificial sunlight baths would become as customary as ordinary bathing.

The place for irradiation by ultra-violet rays was not a cold bathroom, as he had seen suggested, but a warm sitting-room, or a bedroom, where the treatment could be had in warmth and comfort before retiring. With reasonable care the treatment was a very harmless one; its administration only required a little common sense. An over-exposure would produce an erythema (inflammation of the skin accompanied by soreness) similar to the familiar sunburn so prevalent at the seaside at holiday time. It was absolutely essential to protect the eyes from the rays; the usual method was to wear dark glasses tested for their opacity to the ultra-violet rays. It was also necessary to screen the back of the head and neck from the rays to avoid sunstroke; this could, of course, be done by wearing a suitable head-covering.

If not over-indulged in, the treatments produced a feeling of exhilaration and well-being which it was difficult to describe. On the other hand, a too frequent exposure to the rays would tend to produce the reverse effect, and cause a feeling of lassitude. This should be taken as Nature's warning to abstain for a few weeks, after which the treatments could be resumed.

NEW PHASE IN GAS INDUSTRY.

Low Temperature Carbonisation Adopted by a South London Company.

An agreement has been concluded between the South Metropolitan Gas Company and Low Temperature Carbonisation, Ltd., whereby the South Metropolitan Gas Company will undertake the manufacture, under licence, of coalite, the smokeless fuel produced by the British Parker system of

low temperature carbonisation.

A plant capable of distilling over 2,000 tons of coal per week by this process will be erected at once at the West Greenwich works of the South Metropolitan Gas Co. The new works will be similar in principle to the present plant of Low Temperature Carbonisation, Ltd., at Barugh, Yorkshire.

The South Metropolitan Gas Co. will thus become the first gas company in Great Britain to put into operation a commercially tried British process of low temperature carbonisation.

Hitherto, the gas industry in this country has employed the high temperature method which leaves gas coke as the residual product after extracting gas, tar and other elements from the coal. The Parker low temperature method produces from small coal a smokeless fuel of high radiant efficiency suitable for ordinary household grates, in addition to valuable by-products such as crude oil, motor spirit and rich gas.

SIR JOHN RHYS MEMORIAL LECTURE.

PROF. J. E. LLOYD ON "THE WELSH CHRONICLES."

Professor J. E. Lloyd, of University College, North Wales, delivered this year's Sir John Rhys Memorial Lecture at a meeting of the British Academy held on December 12, at the Academy's Rooms, Burlington Gardens. The subject of the lecture was "The Welsh Chronicles." Professor T. F. Tout, Fellow of the Academy, was in the chair.

The Lecturer dealt with the Welsh medieval chronicle known as "Brut y Tywysogion," or the Chronicle of the Princes, which the older historians attributed to Caradog ofLlancarfan. In form it was a continuation of the well-known "Brut y Brenhinoedd," or Chronicle of the Kings, the Welsh version of Geoffrey of Monmouth. But it was very different in substance, being sober history recorded from year to year by clerical annalists. The attribution to Caradog was due to the epilogue of Geoffrey's work, but there was no reason to think that this writer, the author of a life of Gildas, had ever carried out the suggestion of his brilliant contemporary. On the contrary, a marked feature of "Brut y Tywysogion" was its total neglect of Caradog's country, Glamorgan. It existed in three different Welsh forms, agreeing in substance, but differing greatly in language. There could be little doubt that these were parallel translations of one Latin original, which no longer existed in any form. We might learn something of its nature from the Latin texts printed as "Annales Cambriæ"; these, however, were much abbreviated, and had little of the vivacity and picturesque detail which often characterised the Brut.

Internal evidence would enable us to follow the fortunes of the Brut. It began as a chronicle kept at St. David's, and retained that character until the Norman Conquest of South Wales. About 1,100 it was moved to Llanbadaru, near Aberystwyth, and for thhe next 20 years was a record of great interest, describing events in Ceredigion, Powys, and Ystrad Tywi with great fullness, and reflecting the opinions of an ecclesiastic who favoured Powys and Henry I. against the dynasties of Gwynedd and Dehenbarth. After some fluctuations, the chronicle passed about 1170 to the new abbey of Strata Florida, which, almost from the day of its foundation, was a Welsh establishment and a fitting home for a national record. Some of the material no doubt came from other Cictercian houses, such as Caerleon and Basingwerk; with Margam, it was clear, the chronicler had no communication. The time was ripe for a new edition of "Brut y Tywysogion," exhibiting the various texts in their true relation.

Proceedings and Notices of Societies

ROYAL SOCIETY OF ARTS.

COMPETITION OF INDUSTRIAL DESIGNS.

The recently issued Report on the Society's Fifth Annual Competition of Industrial Designs for 1928 indicates that these competitions are becoming better known and therefore more important each year. Success, however, lies rather in quality than quantity and in future competitions it is hoped that the standard attained will be progressively higher. The Competition, which is open to students of Schools of Art and kindred Institutions throughout the Empire, as well as to non-students of all ages, is growing in importance every year. It affords young and unknown designers and craftsmen a unique opportunity of displaying their talent to manufacturers and others interested in Industrial Design, the Exhibition being visited by the representatives of a large number of firms in search of designers with merit and fresh ideas in the treatment of the various subjects of the Competition.

It is felt that by holding these annual

competitions of Industrial Designs the Royal Society of Arts is carrying on a useful piece of public service.

The Prospectus and Schedule of Prizes for the Sixth (1929) Competition is in course of preparation and it will be ready for issue early in January next. Valuable Scholarships and Prizes amounting to about £1,750 will be offered for designs for Architectural Decoration, Textiles, Furniture, Book Production, Pottery and Glass, Posters, Press advertisements, Christmas Cards, Calendars, etc.

ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, London, W.1.

CHRISTMAS (JUVENILE) LECTURES.

Juvenile Lectures this year will be given in the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2. (kindly lent by the Council for these Lectures). The hour of Lectures is 3 o'clock. The subject of the series is " Sound Waves and their Uses," by Alexander Wood, M.A., Tutor of Emmanuel College and Lecturer in Physics, University of Cambridge, to be given as follows :—

Thursday, December 27, 1928.

I.—WAVES.

Waves play a very important part in our lives. We communicate with one another in conversation by sound waves. The telephone changes sound waves into waves of electric current and transmits them along wires. The microphone also transforms sound waves into waves of electric current, and these again may be transformed into electric waves in space and used in broadcasting. The eye depends for all its seeing on light waves. All these different kinds of waves behave similarly in many respects. We shall study the common properties of waves, giving special attention to the pressure waves in air which our ears receive and interpret as sounds. We shall also see how these waves have been made visible to the eye, and photographed so that their behaviour may be studied at leisure.

Saturday, December 29, 1928.

II.—SIGNALLING IN AIR AND WATER.

Sound waves may be used for signalling. During a fog on the coast many lighthouses use sirens as fog horns to warn ships of their position when the light cannot penetrate the fog. Atmospheric conditions often limit very greatly the range of such signals. If the sound is made under water, its transmission in the water is independent of the atmospheric conditions, and it can be picked up at much greater distances. The depth of water below a ship can also be determined by producing a sound at the surface, and timing the interval until the echo from the bottom can be heard. If the sound is of very high pitch—above the pitch to which the ear is sensitive—the sound waves, if we may still call them so, may be projected as a beam, and the reflected beam may be used for detecting icebergs in a fog and other unseen obstacles to shipping.

Tuesday, January 1, 1929.

III.—NOTES AND NOISES.

All sounds can be roughly divided into *notes* and *noises.* We shall be doubtful into which class to put some sounds, but with most we shall have no difficulty. Noises are for the most part disagreeable. Notes are usually pleasant. They are characterised by a certain smoothness and uniformity, and we can assign to them a definite pitch. Notes differ from one another in loudness and in quality as well as in pitch. The differences in quality suggest that musical notes are not so simple as we sometimes think them, and this fact will be borne out by our study of them. Pairs of notes when sounded together sometimes produce a pleasing impression, and are said to be consonant. Sometimes they produce an unpleasant sensation, and are said to be dissonant. We shall try to find some explanation of this fact. In music we only use a certain selection of all the possible notes that are available. The selection we have made has been unconsciously guided by certain physical principles which we can now appreciate.

Thursday, January 3, 1929.

IV.—ANALYSIS OF SOUNDS.

We have seen that differences in quality are due to the fact that musical notes are not as a rule simple. Each single musical note really carries with it a whole series of simple tones known as its " partial " tones. The relative strength of these determines the quality of the note. With a little practice the unaided ear can detect several of these in any given note. This power of analysis is one of the most wonderful powers which the ear possesses. Sounds may be analysed by resonance. If a note is sung in front of the strings of a pianoforte with the loud pedal down so that the strings are free to vibrate, the partial tones in the note will cause the corresponding strings to vibrate. If we have some way of observing which strings are vibrating, we can tell the partial tones which the note contains. A note can also be analysed by obtaining a photographic record of the vibration of the air

which produces it. The resulting graph is analysed by a machine known as a harmonic analyser.

Saturday, January 5, 1929.

V.—THE EAR AND WHAT IT DOES.

The ear is a very wonderful mechanism. It is for convenience divided into three parts—the inner, middle and outer ear. It is really a detector of minute changes of pressure, and provided these are of about the right rapidity it is extremely sensitive. Its action is not fully understood, but its power of analysis suggests that it contains small structures which play the part of resonators tuned to a series of notes covering the range of audible sounds. Its mechanism must also account for consonance and dissonance. The two ears acting together enable us to determine the direction in which a source of sound lies. In order that the ear may appreciate sound and music in a room or hall certain conditions must be satisfied. It is now possible to plan a room so as to obtain any desired acoustic result, and make it satisfactory for the kind of sounds for which it is designed. If certain simple principles are taken into account, we shall have no more halls in which the speaker cannot be heard.

Tuesday, January 8, 1929.

VI.—THE RECORDING AND REPRODUCTION OF SOUND.

During the last few years great strides have been made in the recording and reproducing of sound. Broadcasting depends on the transformation of souud waves into electrical waves back into sound waves again. This involves an efficient microphone and an efficient loud speaker. The gramophone depends upon the recording of sound waves on a wax disc and the reproduction of sound waves again by the communication to a sound box of vibrations similar to those originally recorded on the disc. It is also possible now to record scounds photographically on a film, and, using a photo-electric cell, to produce a varying electric current from the film which can in turn be transformed into sound by a loud speaker. This is the principle underlying the talking film. Some of the apparatus used in these processes will be explained and discussed.

THE OPTICAL SOCIETY.

At the meeting of the Optical Society held at the Imperia lCollege of Science and Technology, South Kinsington, on Thursday, 13 December, 1928, the following papers were read and discussed :—

Note on Skew Pencils Traversing a Symmetrical Instrument. By T. SMITH, M.A. F.Inst.P. (Optics Department, The Nationa. Physical Laboratory).

Image points on a chief ray in a primary plane of a symmetrical instrument for which the light path is constant for a light fan lie between the primary and secondary foci. When the chief ray is skew this is no longer generally true. The absence of astigmatism in a pencil of which the chief ray is skew involves three conditions.

The Measurement of Axial Aberrations of Telescopic Systems of Small Magnification. BY B. E. MOURASHINSKY AND MISS M. SAVOSTIANOFF. (Optical Institute, Leningrad.)

The aim o fthis work is to give a method for the measurement of axial aberrations (spherical and chromatic) of a telescopic system of small magnification. The dioptric expression for an axial aberration is given and the special advantages of such a dioptric expression for the experimental measurement of aberrations are pointed out. The principal peculiarity of a dioptric expression for axial aberration is the fact that the shape of a curve of spherical aberration remains unchanged if the focussing is varied.

The arrangements used in measuring axial aberrations are described. The method of theh measurement consisted in getting two out of focus photographs of a slit or pinhole placed in the focus of a collmating object-glass and illuminated by monochromatic light. The object-glass of a system to be measured was covered by a diaphragm with slit or round hole apertures. The distance between the two photographic plates and the distance between the traces for two definite slits or holes on both the plates having been measured, it was possible to get the value of the angle between a given ray and the axis of the system. By means of this angle and the exit height (in the exit pupil) we get the distance of the intersection of the exit ray with the axis of the system from the centre of the exit pupil. The values of these distances, as expressed in dioptres, for the series of rays for different entrance or exit heights and for different wave-lengths being known, the curves of spherical aberration can be traced.

The aberrations of a number of binocular telescopes were measured to test this method. The results of the measurements for three telescopes are given in the paper. The data for one of these telescopes are given in more detail to show the attainable accuracy of the measurements. The results

with those obtained by means of a slit diaphragm. Also the results obtained in focussing the system 0D (infinity) and - 4D were compared. The discrepancies in both cases lie within the limits of error. The measurements of aberration of one of the telescopes were compared with the aberration curve obtained by means of computations for the other telescope of the same binocular.

Two telescopes showed so-called axial astigmatism and axial coma. The presence of axial astigmatism and axial coma is caused by insufficiently careful adjustment and centering of the optical system of these telescopes.

ROYAL AGRICULTURAL SOCIETY.

At the monthly Council Meeting on December 12, the following report of the Chemical Committee was considered among others.

Mr. H. Dent Brocklehurst (Chairman) reported that the list of samples analysed by the Consulting Chemist for the month of November had been considered the annual report for 1928 of the Consulting Chemist. This, with certain amendments, had been passed for publication in the next Volume of the Journal.

The Consulting Chemist had presented the following report on matters arising out of his correspondence :—

Chilian Peas.—The risk attending the use of foreign peas of unknown nature is shown by a case, brought to my notice, in which a purchase had been made of 4 tons of what were called " Chilian Peas." These peas had been ground and mixed with barley and given to pigs, with the result that 10 were poisoned. On examining the " peas," though I was unable to recognise the particular variety, I found that they gave, on grinding up, a distinct " bitter almond " smell, and, on macerating them with water and gently warming, prussic acid was given off. These peas, like Java beans and some others, evidently contain cyanogenetic glucosides giving rise, on fermentation, to prussic acid.

Linseed Used for Boilers.—One of the ways adopted for preventing the incrustation of boilers is to use lnseed. A sample sent me of linseed which had been so used, was found to me very acid and to have a pungent taste. I, accordingly, advised the member who sent it me that it was not a fit material for feeding.

The Committee estimated that for the ensuing year their expenditure would amount to £400, the Consulting Chemist's salary, plus the amount of the Laboratory petty cash. The Committee had met eight times and had made eight reports during the year. obtained by measurements with a round hole and round apertures were compared

MANCHESTER UNIVERSITY.

The Council have decided to apply the bequest of £1,000 received under the will of the late Mr. Tom Jackson, of Bolton, in the foundation of an entrance scholarship bearing his name.

The Council have accepted the resignation of Mr. J. Stuart Thomson, M.Sc., Ph.D., senior lecturer in zoology.

The following appointments and elections are announced :—

Mr. J. W. Cuthbertson, M.Sc. (Manchester)—assistant lecturer in metallurgy; the Bishop of Middleton (Dr. R. G. Parsons)—Dean of the Faculty of Theology. Honorary research Fellowships in physics—Dr. A. G. Bradley, Dr. Szabo V. Naray, Dr. Felix Machatshchki, Mr. J. West, Dr. W. H. Zachariasen. Research studentships—Mr. H. Walkden (in botany), Dr. W. Albrecht (in physics).

LONDON UNIVERSITY.

Examination Results.

Third (M.B., B.Sc.) Examination for Medical Degrees (Internal and External).—Honours.—Ayres, G. W. (*d*), St. Mary's Hosp.; Cooper, Elizabeth (*b*), London (R.F.H.) Schl. of Med. for Women; Himsworth, H. P. (*a*, *b*, *c*, *University Medal*), Univy. Coll. Hosp.; Keele, C. A. (*a*), Midx. Hosp.; Rake, G. W. (*a*, *d*), Guy's Hosp.; Reid, R. W. (*b*, *d*), St. Thom. Hosp.

(*a*) Distinguished in Medicine. (*b*) Distinguished in Pathology. ((*d*) Distinguished in Surgery. (*c*) Distinguished in Midwifery.

ROYAL SOCIETY OF ARTS.

Competition of Industrial Designs, 1928.

The Annual Competition of Industrial Designs was held for the fifth time this year. With regard to numbers of candidates and designs there has been an increase of nearly fifty per cent. over the figures of 1927, *viz.*, 1,024 candidates, and 3,126 designs, as compared with 745 candidates and 2,224 designs last year, and this in spite of the fact that it was found necessary to make certain additions to the entry fees.

The increase is no doubt largely due to the number and value of the prizes affered. Altogether these amounted to over £1,600, including Travelling Scholarships of £100 and £75, and a large number of prizes of £50 and under.

NUMBER OF ENTRIES.

The total number of competitors who entered for the various sections of the Competition was 1,024. Of these, 739 were students of Schools of Art, and 285 non-students.

The number (of mounts) of designs submitted was 3,126, divided as follows :—

Architectural Decoration	305
Textiles	959
Furniture	152
Book Production	206
Pottery and Glass	364
Miscellaneous	1,140
Total	3,126

LIVERPOOL UNIVERSITY.

Professor James Henry Dible, M.B., Ch.B., M.R.C.P., Professor of Pathology and Bacteriology, Welsh National School of Medicine, Cardiff, has been appointed to the George Holt Chair of Pathology.

Professor Warrington Yorke, who has held the Walter Myers Chair of Parasitology in the University since 1914, was appointed to the Alfred Jones Chair of Tropical Medicine as from January 1, 1929.

THE GEOLOGICAL SOCIETY.

A meeting was held on December 19. Dr. C. A. Matley, F.G.S., delivered a lecture on "*A Visit to the Crater of Papandajan* (Java)." The following communication was also read :—" The Geology of the District between Llanymawddwy and Llanuwchllyn (Merioneth)," By Professor W. J. Pugh, O.B.E., B.A., D.Sc., F.G.S.

At the meeting on January 9, 1929, a lecture will be delivered on " The History of the Yellowstone Cañon, Yellowstone National Park (U.S.A.) " by Prof. O. T. Jones, M.A., D.Sc., F.R.S., F.G.S.

SOCIETY OF GLASS TECHNOLOGY.

Meetings of the Society were held in University College, London, on December 19. The following papers were read and discussed :—

A Brief Outline of the History, Development and Methods Employed in the Manufacture of Laminated Glass." By W. R. Lyttleton (Managing Director, The Triplex Safety Glass Co., Ltd.).

A Simple Test for the Detection of Iron Oxides in Glass Sands, and

Note on the Reduction of Glasses in Hydrogen. Both by J. T. RANDALL AND R. E. LEEDS. (Communications from the Research Laboratories of the General Electric Co., Ltd., Wembley).

NOTICES OF BOOKS.

THE AMERICAN PROHIBITION OF ALCOHOLIC BEVERAGES.

Prohibition Still at Its Worst. By IRVING FISHER, assisted by H. BRUCE BROUGHAM. Pp. xxviii + 358. New York : Alcohol Information Committee. 1928. Price $1.75.

Prof. Irving's important book deals with the controversial queston of the good or bad influence and results of the introduction of laws prohibiting the sale and consumption of alcoholic beverages in the United States of America. He has collected the opinions *pro* and *con* of eminent leaders and has endeavoured to draw unbiased conclusions from the mass of facts which both sides (those in favour and those opposed to prohibition) have advanced.

All right-minded persons must agree that it is desirable to restrict and eliminate insobriety and the evils which so frequently attend the immoderate, and even the " moderate " use of alcoholic drinks. The imposition of a direct prohibition of their consumption is, however, a more serious matter and involves other questions. Should a body of men, or even a majority, enforce their wishes upon others who alone would feel the effects of the change? Even if it is for the benefit of those who would be called upon to give up the use of alcohol and even though it is the better type of citizen who urges the enforcement of prohibition for the good of his less enlightened neighbour the question cannot be dismissed without consideration.

One unfavourable aspect of attempting this enforcement is that those who crave for alcoholic drinks, especialy those addicted to spirits, will adopt ways and means of evading the law whenever possible and this has actually taken place in the United States. To what extent the law has been broken is probably not known but there can be no doubt that there has been great contempt for the law and considerable evasion. Also it has led to illicit traffic in poisonous concoctions which pass off as "beverages."

Nevertheless, after weighing the evidence Prof. Fisher has arrived at the conclusion that prohibition has done much good and that its complete enforcement will be a great boon to the nation. He finds that scientific investigations of the effect of moderate drinking indicates unmistakeably that the evidence is in favour of total prohibition. It has meant an " economic gain " to the nation of six billion dollars and no economist

has challenged its economic advantages. The amount of "bootleg" liquor which is consumed is claimed to be rapidly diminishing and its high cost limite its purchase to those of the upper classes of the United States who are prepared to pay excessively for very inferior beverages.

The Report of the British Medical Research Council (1924) is quoted to show that the rate at which alcohol is burned in the body is much slower than has hitherto been supposed, thus explaining the cumulative effect of drinking at short intervals. This, it is contended, negative the general conclusions contained in the report that "moderate" drinking, as borne out by the massive experience of mankind in countries where wine and beer are regularly consumed, is beneficial rather than harmful.

Reference is made to the state of affairs in Canada and it is claimed that conditions in Quebec show that the plan of Government dispensaries for the sale of fermented beverages is not a success.

Finally, Prof. Fisher claims that prohibition has already accomplished incalculable good, hygenically, economically and socially; it has led to the adoption of better uses of leisure.

Quantentheorie und Chemie. By Dr. H. Falkenhagen. Pp. 142. Leipzig: S. Hirzel. 1928. Price, 10 marks.

This volume is a compilation from the "Leipzig Lectures" of 1928 and opens with that of Prof. W. Kossel on "Molecular Occurrences in Crystal Growth." Dr. London's contribution on "The Quantum Theory and Atomic Binding," and Dr. A. Eucken's paper on "The Heat Conductivity of Metals and Non-Metals" are the only other German works included, whilst Prof. Sidgwick's "Role of Electrons in Chemical Union," Hinshelwood's "Problem of Energy Changes in the Kinetics of Chemical Reactions," and Prof. Dirac's "Quantum Theory of the Electrons," constitute the British contributions.

Finally, there is a paper by Prof. Fermi, of Rome, on "The Application of the Statistical Method to the Problems of Atomic Structure."

The U.S. Department of Commerce.

This body has just issued (price 5 cents) the Annual Report of the Director of the Bureau of Standards for the year ending June, 1928.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.
Arrangements for Meetings during January, 1929.

Wednesday, January 16, at 8 p.m.—(Ordinary Meeting). Professor Charles R. Darling, A.R.Sc.I., F.I.C.: "The Domestic Smoke Problem—A Practical Solution."

Monday, January 21, at 8 p.m.—(Cantor Lecture.) C. H. Lander, C.B.E., D.Sc., M.Inst.C.E., F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research: "The Treatment of Coal." (Lecture I.)

Wednesday, January 23, at 8 p.m.—(Ordinary Meeting). Sir Henry A. Miers, F.R.S.: "Museums and Education." The Right Hon. the Earl of Crawford and Balcarres, K.T., P.C., LL.D., F.R.S., P.S.A., will preside.

Monday, January 28, at 8 p.m.—(Cantor Lecture). C. H. Lander, C.B.E., D.Sc., M.Inst.C.E., F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research: "The Treatment of Coal." (Lecture II.)

Wednesday, January 30, at 8 p.m.—(Ordinary Meeting.) George Fletcher: "The Shannon Scheme and Its Economic Consequences."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

35,497. Blanc, G. A.—Removal of ferric chloride during treatment of leuctie. December 11th.

36,098.—Consortium fur Elektrochemische Industrie Ges.—Manufacture of trichlorethylene. December 14th.

36,394.—I. G. Farbenindustrie Akt.-Ges. —Recovery of nitric acid.

36,407.—I. G. Farbenindustrie Akt.-Ges. Manufacture of 4-chloro-1-amino-antraquinone-2-sulphonic acid. December 10th.

36,313.—Nicoresti, C. A.-Colman.—Gelification and solidification of alcohol. December 10th.

Specifications Published.

286,207.—Ault & Wiborg Co.—Methods of and apparatus for treating hydrocarbone to obtain ink.

301,956.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges).—Process for the *manufacture of amino* alkyl ethers of oximes and their salts.

301,955.—Bloxam, A. G. (Allgemeine Ges fur Chemische Industrie).—Purification of petroleum hydrocarbons.

302,129.—Weil, J. A., Rawlinson, H., and Imperial Chemical Industries, Ltd. —*Manufacture and production* of ammonium vanadate and of vanadium pentoxide.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by *permission of the Controller of* His Majesty's Stationery Office.

KIFLU.

494,356.—Chemical substances used in *manufactures, photography* or philosophical research, and anti-corrosives. — Ring Gesellschaft Chemischer Unternehmungen mit Beschränkter Haftung, Osnabruckerstrasse 98, Seelze, near Hanover, Germany. December 19th.

NARCOSAN

493,964.—A medicinal preparation for human use.—*Lipoidal* Laboratories Inc., 67, Fulton Street, City, County and State of New York, United States of America. December 19th.

ASMADYN.

496,555.—Chemical substances prepared for use in medicine and pharmacy.—Thomas Hubert Stephens, 104, High Holborn, London, W.C.1. December 19th.

NEMOSAN.

495,977.—Chemical substances prepared for use in medicine and pharmacy. —Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. December 5th.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the *curriculum*.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices: Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices: Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
16, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3587.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.

Printing Works: Hop 2404.

CONTENTS. PAGE.

The Absolute Zero of Temperature; The Specific Heats of Gases; and Deductions Respecting Quanta ... 18
By F. H. Loring.

Paper Pulp and Cellulose from the Eucalypts by the Sulphite Process 22
By L. R. Benjamin and J. L. Somerville, B.Sc.

General Notes ... 24

Studies of the Galactic Centre. The Programme for Milky Way Variable Stars ... 27
By Harlow Shapley.

Proceedings & Notices of Societies:—
The Chemical Society ... 28
The Royal Institution ... 29

Correspondence — Carbon Monoxide Danger ... 29

Forthcoming Events ... 30

New Patents ... 31

New Trade Marks ... 32

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net: Carriage paid to Foreign Countries and the Colonies, 23/- net.

CITY OF CARDIFF.

PUBLIC HEALTH DEPARTMENT.

PUBLIC ANALYST.

Applications are invited for the combined Appointment of

PUBLIC ANALYST AND AGRICULTURAL ANALYST.

at a salary of £500.

Candidates must hold the Diploma of Fellowship of the Institute of Chemistry, together with the Certificate granted by the Institute after an examination conducted by them in the Chemistry (including Microscopy) of Food and Drugs and Water. It is also desirable that Candidates should hold the Diploma in Agricultural Chemistry granted by the Institute of Chemistry.

The person appointed will be required to devote the whole of his time to the duties and to contribute 5 per cent. of his salary under the Superannuation Scheme of the City Council, and for this purpose to pass a medical examination. The contributions and benefits in connection with superannuation will commence as from the date of commencement of duty.

Forms, on which application must be made, may be obtained from the undersigned, to whom they should be returned, accompanied by copies of three recent testimonials, and endorsed "Public Analyst," not later than 31st January, 1929.

RALPH M. F. PICKEN,
Medical Officer of Heatlh.

City Hall,
Cardiff.
January, 1929.

R. ACETONE, ACETONE FERMENTATION, ACETONE SYNTHETIC AND RADIUM COMPOUNDS.

The Treasury have made an Order under Section 10 (5) of the Finance Act, 1926, continuing till 30th une, 1929, the exemption from duty of R. acetone, acetone fermentation, acetone synthetic and radium compounds.

The Treasury Order will shortly be published by the Stationery Office.

19 December, 1928.

THE ABSOLUTE ZERO OF TEMPERATURE; THE SPECIFIC HEATS OF GASES; AND DEDUCTIONS RESPECTING QUANTA.

By F. H. Loring.

In this Journal (1928, 137, 370) I contributed a note on the absolute zero value in degrees −C. I here offer one or two additions thereto, which may be of interest in connection with the numerical relations previously given. Some deductions will follow.

In these studies I believe that the constants computed are close to the best determinations and that the following citation bears evidence of good choice in one or two respects, judging from the support tacitly given by the distinguished authorities here named.

In the treatise: THERMISCHE EIGENSCHAFTEN DER STOFFE, compiled by C. Drucker, E. Grüneisen, P. Kohnstamm, F. Körber, K. Scheel, E. Schrödinger, F. Simon, J. D. Van der Waals, Jr.—Edited by F. Henning, 1926, S.vii (1925—*Erläuterungen und Bergründungen s. ds. Handb. II*, Artikel Henning-Jaeger) the value for the absolute zero is given as −273.2$_0$°. This is practically the exact value I have computed, which was referred to before, but without the further endorsement here given.

As I will pass to another computation, involving the absolute zero value, as previously calculated, namely, −273.1944, and involving Avogadro's number together with specific heat constants, I will cite further from the above treatise. Avogadro's number is there given as $6.06_1 \times 10^{23}$. The *International Critical Tables*, 1926, vol. I, p. 18, gives this value as 6.061, with the same multiplier of course. Jeans in his DYNAMICAL THEORY OF GASES, 1925, uses the value 6.062. J. K. Roberts in his HEAT AND THERMODYNAMICS, 1928, p. 60, gives the value 6.064.

Having strengthened, to some extent at least, my claim for accuracy—if it may be so stated, I will now attempt to 'calculate' the proper ratio (γ) of the specific heat at *constant pressure* (C_p) to the specific heat at *constant volume* (C_v), the substance being a monatomic gas, such as helium or argon: *i.e.*, $C_p/C_v=\gamma$. In this case the number of atoms becomes involved, so taking Avogadro's number at the *lower* value and my previously computed value for −C° absolute zero, as given above, the following relation seems to obtain:—

$$(6.061 \times 10^{23})/(10^{26}/273.194) = 1.65309 = \gamma$$

Travers' early value for He is 1.652, as cited in his book THE DISCOVERY OF THE RARE GASES, 1928, p. 36 *et seq.* In Jeans' book (*loc. cit.*) γ is given as 1.654, being based upon the determinations of Scheel and Heuse (*Ann. d. Phys.*, 1913, 40, 473; see Heuse, *ibid*, 1919, 59, 86). U. Behn and H. Geiger (*Verh. d. D. Phys.*, 1907, 9, 657) had obtained the value 1.63. Scheel in the treatise cited above (p. 340) gives for He $C_p=5.004$ and $C_v=3.017$. This gives $\gamma=1.658$. Also for Ar $C_p=5.07$ and $C_v=3.07$, making $\gamma=1.651$. Now the mean of these two values of γ is 1.655, which practically agrees with the value above calculated.

It should be noted that these Scheel and Heuse values are at 18° and 15° C., respectively. At 0° C. the values would be practically the same, as in the case of He at −180° C. the value of γ is not very different, namely, 1.671. Based on my equation above, and accepting the experimental value of γ at 0° C. as 1.656, Avogadro's constant comes out at 6.0616×10^{23}.

In this coincidence the values used refer to atoms which are supposed to be *spherical*, which means the monatomic inert gases. Mercury vapour has a similar value, 1.666, being monatomic, as is well known as it belongs to this class.

From the kinetic theory of gases the ideal value is supposed to be $5/3=1.\dot{6}$. If, however, the constants are shaped to give this value they do not quite agree with the best experimental values; and, moreover, in establishing this relation, it is questionable whether any gases should be used other than those which are monatomic *and* perfectly inert chemically.

Before discussing these correlationships, as connoting some physical meaning, I will add an observation that is perhaps evident, since misunderstandings must be guarded against. Referring to my first note, the constant Δ_n can be eliminated by using h instead, as one constant is evolved in a sense reciprocally from the other. I have introduced Δ_n to show how the study originated —at least in part. This makes no difference either in the argument or in the computed value. It merely means an obvious reconstruction of the last equation in my first note. It may be that this reconstruction should be used in order to see whether the relation in question would lead to a better understanding of some of the constants used to obtain it. This is given below in connection with an argument. The new physics, if I may so term it, involves constants though interpreted in a more or less accurate way, still leave room for improvement. The

following is an attempt in this direction, though I fear a very imperfect one.

Now assuming the above relation to be a true one at 0° C., *i.e.*, at 273.2°C. above the absolute zero, the ratio, γ, involves specific heat quantities that are of the nature of *elasticities*, C_p corresponding with *adiabatic elasticity*, and C_v corresponding with *isothermal elasticity*. Elasticity in turn involves *stress/strain*. These basic statements are of course well known.

From my equation above, C_p corresponds with *Avogadro's number* as possibly a sort of scale factor, and similarly C_v corresponds with *the absolute zero of temperature reciprocally*. The temperature value (see equation above with reference to the one to follow here) was arrived at by the equation :

$10^2/24\Delta_a = 273.194 = h/24 \times 10^{-30}$. h *is therefore of the nature of an isothermal elasticity*. Now since $c = R_\infty/(24 \times 10^{-33}/h)$, c involves this elasticity factor, so to speak. c is, however, a *spreading constant and involves velocity*. As Eddington says in his THE NATURE OF THE PHYSICAL WORLD, 1928, p. 202—" The characteristic of a wave-theory is the spreading of a ray of light after passing through a narrow aperture—a well-known phenomenon called diffraction." Since h is of the nature of *energy divided by frequency*, this ' *action*,' otherwise expressed as *energy* × *time*, must involve, as it were, an *elasticity coefficient*, which may be taken as that of the æther, and it determines the *spreading constant* c.

This suggests to me that $h\nu$ is a quantum of energy that becomes elastically extended in the æther. Therefore, to talk about a quantum as if it were *always* a speck is, perhaps, absurd, for it becomes an extended action, and I believe that this fits in with the new wave-mechanics. Is it not like a small pure-rubber* ball that can be blown out to larger and larger diameters, for the bigger it gets the easier it spreads, hence the velocity of its spreading is c? It might be like an inner tyre that had been over-inflated and suddenly expands to huge dimensions. Or as Nordmann has put it : *a gun firing blank cartridges*, which means expanding puffs of air. See *Chemical News*, 1928, 136, 1.

There is nothng so annoying in science as to be referred to something of great interest without some sketch being given of it. I will, therefore, attempt a brief outline of Louis de Broglie's theory. In doing this I am going to draw heavily from a remarkably good account of this theory which Prof. Stanley Allen has given in his book THE QUANTUM AND ITS INTERPRETATION, 1928, pp. 201-203. De Broglie starts with the assumptions that (1) each and every light quantum has a sort of rest mass which value is designated by m_0, and, at the most, would be of the order of 10^{-50} gram. That (2) the velocity of this ' mass,' v, is not experimentally distinguishable from the limiting velocity of light c. That (3) the frequency is connected with the whole energy of a quantum by the relation—

$$h\nu = m_0c^2/(1-\beta^2)^{\frac{1}{2}}, \text{ where } \beta = v/c.$$

The light quantum has an internal two-fold symmetry corresponding to that of an electromagnetic wave and defined by some axis of polarisation.

Joining the Lorentz-Einstein transformation with this quantum relation leads to the motion of the body being tied up with a wave propagation. Accordingly, a body moving with a velocity v relative to an observer, which is βc, β being less than unity, is accompanied by a wave of frequency ν which spreads with the velocity $c/\beta = c^2/v$. This wave does not, however, carry energy and therefore does not violate Einstein's ideas. A group of waves the frequencies of which nearly coincide has a group velocity which is the velocity of energy propagation as ordinarily understood. Allen says : " It is suggested that the velocity of the moving body is the energy velocity of a group of waves having frequencies determined by the above equation and velocities c/β corresponding to very slightly different values of β.

In accordance with Einstein's mass-energy principle, m_0 contains energy equal to m_0c^2. The above quantum relation allocates the energy in some internal phenomenon of frequency ν_0 as given by the equation $h\nu_0 = m_0c^2$.

If at the inception of the phenomenon under discussion it is in phase with the wave it will persist, which serves to give an interpretation of Bohr's stationary states or stability conditions, " for it suggests that the motion of the electron in its trajectory can only be stable if the phase wave is tuned with the length of the path." That is to say, the encircling waves (so-called de Broglie waves) that go round the nucleus must exactly fit as they come round. A somewhat similar suggestion was made by G. P. Thomson (*Phil. Mag.*, 1925, 50, 163) as applied to tubes of force connecting the electron with its nucleus which are in tune with the period of the orbit.

* Like rubber, only *more so*—to use one of Eddington's happy phrases, here in italics.

De Broglie's theory indicates that the waves emanating from a source spread out in all directions and that the light quantum, or photon in the newer phraseology, follows the normal to the wave surface. Allen says: "Thus the quanta, moving with a speed slightly less than that of light, are constrained to follow paths which will satisfy the requirements of interference." De Broglie says:— "When an atom emits a light quantum, a spherical phase wave is simultaneously emitted and, crossing over the neighbouring atoms of the point source, will excite other emissions. The non-material phase-wave will carry many little drops of energy which slide slowly upon it and whose internal phenomena are coherent." I will now quote steadily on from Allen's book, but the equations will be arranged for machine composition, as I have been doing in these columns for some time.

"Starting with the assumption that black-body radiation consists of discrete light-atoms, each having energy $h\nu$ and momentum $h\nu/c$, so that the pressure per unit of boundary surface is $\frac{1}{3}nh\nu$, n being the number of atoms in unit volume, de Broglie (*J. de Physique et le Radium*, 1922, 3, 422) has derived Wien's law of radiation by the methods of statistical mechanics. To obtain the correct numercal factor which is twice that found theoretically, he adopts a suggestion of Brillouin that each light-atom is associated with an internal state of right- or left-handed circular polarization.

"H. A. Lorentz esteems the theoretical significance of the *energy fluctuations* of so much importance that he expects to find here the key of the whole radiation problem. Supposing the mean energy E of a system to be known as a function of the absolute temperature T, statistical mechanics supplies an expression for the mean square of the energy fluctuations Δ.

$$\Delta^2 = kT^2(dE/dT),$$

where k is Boltzmann's constant†. Here Δ represents the deviation from its mean value E of the instantaneous value of the energy contained in volume V within the frequency ν and $\nu + d\nu$.

"Assuming Planck's law of radiation in the form

$$E = 8\pi h\nu^3 V d\nu / c^3 [(e \text{ exp } h\nu/kT) - 1]$$

we find

$$\Delta^2 = h\nu E + (c^3 E^2 / 8\pi\nu^2 d\nu V),$$

as Einstein showed in 1911.

"Every hypothesis as to the structure of radiation must be in accord with this equation. The second term on the right corresponds to the entirely electromagnetic Rayleigh-Jeans radiation. The first term corresponds to an entirely quantized radiation, for if we assume that the energy of vibration frequency ν is concentrated in discrete independent quanta of magnitude $h\nu$, we find by analogy with the case of an ideal gas: $\Delta^2 = h\nu E$. But this expression agrees with the previous one only in the region within which Wien's law is valid. Consequently, this form of the light quantum hypothesis must be rejected as too restricted. Einstein later introduced certain hypotheses as to the emission and absorption of light quanta which lead to Planck's formula, and thereby may be expected to yield the exact fluctuation law. L. de Broglie (*Comptes Rendus*, 1922, 175, 811) has also discussed the problem and suggested the existence of agglomerations of 'light-particles' which may be regarded as forming a gas composed of molecules and atoms. On this basis it is possible to deduce the exact law. He supposes that interference phenomena are associated with the existenc of agglomerations of light atoms whose movements are not independent but coherent.

"A possible connection between the wave-theory of matter and electromagnetism has been pointed out by H. Bateman (*Nature*, 1926, 118, 839). In de Broglie's theory a particle of matter travelling with velocity v has associated with it a phase-wave travelling with velocity c^2/v. This theory may be related to J. J. Thomson's theory of moving lines of force by interpreting v as a velocity of the electric line and c^2/v as the velocity of the magnetic line."

Schrödinger has removed difficulties of ordinary mechanics by his undulatory mechanics, so it may be possible to extend the ideas of de Broglie as applied to radiation and ultimately reconcile the light quantum hypothesis with the undulatory theory of light, these being Prof. Allen's concluding remarks on page 208. There is

† [I have been attempting to evaluate some of the principal constants during the past two years and these efforts have been published in these pages. I find, according to my correlationships, that e in electrostatic units is 4.779×10^{-10}. Now it is a curious fact that this value divided into h taken as 6.556×10^{-27} gives the value 1.87197×10^{-17}, Boltzmann's constant (k) being 1.372×10^{-16}. There is, of course, a decimal point difference. Taking the value of e at 4.774×10^{-10} gives 1.8734×10^{-17}. I suppose that this is another chance coincidence.]

much more said on the subject in this interesting book.

The reader will I hope realise how difficult it is to get a full and proper grasp of these new theories, and that two authorities on the subject would not state the same theory in the same way. The points brought out by Prof. Allen, however, seem to fit in partly with the ideas of this article, and therefore, with due apology, I have quoted accordingly.

In this study it is well to note a statement by W. F. G. Swann (*Journ. Franklin Inst.*, 1928, 206, particular page 595), *viz.*, " . . . It is probable that most so-called proofs in physics should be regarded more in the light of showing the analytical equivalence of different statements of law."

Returning to my argument above, I will attempt some further interpretations. I trust that the reader will not mistake assurance of statement for accuracy of fact, as the mystery is still a deep one. Some of the attributes I have attached to the quantities involved are best labelled : *whatever this may mean.*

A wave involves an oscillation arising from an instability; so if c is evaluated from an *isothermal elasticity*, h, *of the æther* and a *convergence frequency constant*, R_∞, *of matter*, so to speak, and distinguished from the æther, in this sense not taken as matter, the latter is rigid yet mobile in the parts like water; while the former is elastic in some way like the air. The water can therefore oscillate, but the induced wave that is spread out in the air corresponds with the æther-wave. The analogy must needs be imperfect. The movement or falling in of the electron in the atom sets up this kind of disturbance, just as the stone would do in falling into water. Now the velocity with which the wave spreads in the æther is governed by h, but the sort of wave *i.e.*, its wave-length and frequency, is governed by the Rydberg constant subject to variations, so that the veocity with which $h\nu$ spreads has nothing to do with R_∞, any more than the velocity of the air waves depend upon the water, but the water must be present in this case, as must R_∞; but the energy of the wave has to do with $h\nu$, so that *all* free-æther waves are propagated with the same velocity c. I believe that this statement is fundamentally important.

The energy is due to ν, that is to say, it varies with ν, h being constant. $h\nu$ in one sense is the nature of a frequency, multiplied by a velocity that is constant, and this is h in some other guise, so that one could almost say that c should equal h. Now to make an equation give the energy, h has to be multiplied by ν, and, on the other hand, to make the foregoing suggested equation balance, h has to be divided into a constant 24×10^{-33}, and the resulting value divided into R_∞. Whether these figures be regarded as conversion factors or not the correct answer is obtained.

I now come to a very curious state of affairs. When the $h\nu$ wave, which is propagated with a fixed velocity c in a vacuum, meets an atom having the R_∞ characteristic alluded to above, something strange happens. An electron is shot out of the atomic system with considerable energy. This occurs no matter how much the quantum $h\nu$ is spread out. There is a proviso, however, the value of ν must correspond with or exceed the energy value that the particular electron could generate as an $h\nu$ wave, when disturbed by the falling-in process mentioned above. That is to say the *first* ν must be equal to or greater than the *second* ν in the wording here.

Now the energy of the incoming $h\nu$ wave is so spread out that its area at the electron would not give this occasional electron a corresponding or sufficient energy. I say *occasional* because it is only " here one and there one " that responds. This is, of course, the well-known photoelectric effect that hardly needs describing here, except that I am describing it in a certain way I believe to be near to the truth. This is, by the way, the rock on which all radiation theories have foundered.

Now since h is an æther constant having an elasticity, *i.e.*, an isothermal elasticity, which I suppose cannot be given up reversibly—*i.e.* the energy involved cannot be made to converge or work backwards—it ceases to function in this case so that the frequency ν can only act, and it has seemingly acted by having empowered the outcoming wave-electron to take up its h, so to speak, as if it were a velocity*, from the æther, since it is then not acting in a *reverse* manner.

Stated in another way, a force coming in from the exterior region of an atom and entering it cannot cause an electron to move out against the direction of such force, but the frequency ν can give rise to a new $h\nu$ coupling, so to speak, as more fully discussed in the accompanying foot-note.

The fact that electrons only here and there respond can be expressed as a consequence of—or, in some way equivalent to—the second law of thermodynamics; but since the response increases as the intensity of the light increases, it is not clear how this law applies, because the random arrangement of electrons cannot be undone by increasing the radiation intensity. If there is no random feature to limit the possibility of more energy being obtained in the end than is supplied at the beginning, then perpetual motion is the result. From these two statements it appears that the views above advanced fail and therefore the problem is as far as ever from solution.

I believe the reason for this failure is that I have been reading the Riot Act to one man (to use Eddington's illustration) whereas, there are in practice many (quanta), and these have "*statistical properties*," and involve just those conditions as in a gas to which the second law of thermodynamics applies, and this obviates the perpetual motion difficulty. — See Eddington's book (*loc. cit.*) p. 201.

P. A. M. Dirac (*Proc. Roy. Soc.*, 1926, 111, 405) has arrived at a mathematical solution of the A. H. Compton effect; and G. Wentzel (*Zeit. f. Phys.*, 1926, 40, 574; *ibid*, 1927, 41, 828) and G. Beck (*ibid*, 1927, 41, 443) have applied wave mechanics to the atom with satisfactory results in respect of the photoelectric effect, so that the solution may not be as far off as some would have us believe.

Whatever be the true theory, the above view, as imperfect as it is, does give some sort of picture of the process.

Attention may be drawn to an article of mine, Radiation and the Photoelectric Effect, *Chemical News*, 1927, 134, 129.

---

* It must be remembered that by the equation given in this article h can be evaluated from c, but berhaps I am attaching too much importance to the evaluations. Still, if they serve some constructive purpose, the scaffolding can ultimately be abandoned. The photoelectric equation is $h\nu = \frac{1}{2}m_0v^2$, but the wave nature of the electron would involve $h\nu$ as belonging to the electron, the equation being a sort of dumb-bell equation. The right-hand part of the equation represents its mass property, and it is thereby restricted in its velocity, so that $h\nu$ in this case cannot move with the velocity c, which is the velocity of light.

PAPER PULP AND CELLULOSE FROM THE EUCALYPTS BY THE SULPHITE PROCESS.

By L. R. Benjamin and J. L. Somerville, B.Sc.

(*Continued from Page 7.*)

Cooking Experiments.

Nature and Scope of Present Investigation.

The nature of the present investigation has been essentially technical and almost wholly directed towards the development of more economical methods of conversion of eucalyptus wood into pulp than those in existence abroad for the pulping of coniferous wood, or, as already indicated, by preliminary experimental work done on a laboratory scale. The scope of the work was necessarily narrowed down by the character of the major problem, namely, the production of news-grade sulphite pulp, and the field was further restricted to the production of a pulp that must needs be used in a different manner from that in which news-grade coniferous sulphite pulp is regularly employed, *i.e.*, it would form the major, not the minor constituent of the paper, and would require beating. The problem thus presented was, firstly, the production of a pulp that woud be sufficiently high in colour not to require bleaching, and yet one that would beat easily and gain strength without becoming so "wet" as to slow down the speed of modern fast-running paper machines; secondly, the achievement of this result by cooking in the shortest time possible with the least loss of valuable fibre.

This was the scope of the problem as defined at the beginning, but as the work progressed certain important features presented themselves, and these have led to a study of the question of producing high-grade cellulose for viscose silk and related purposes. Though even at the present time this question is of secondary economic importance compared with the newsprint problem, the valuable data that could be so readily obtained as part of the investigation were sufficient reason for extending its scope to this extent.

Factors Involved.

The preliminary experiments referred to had indicated clearly the fact that, in applying the sulphite process to the cooking of the eucalypts, the conditions commonly employed in the treatment of conifers could not be expected to result in maximum economy, nor, indeed, in the production of the quality of pulp required for the major

purpose in view, *viz.*, newsprint manufacture.

The principal factors that can be varied and controlled in sulphite cooking are—

1. The composition of the cooking liquor.
2. The ratio of liquor to wood, generally referred to as the "liquor ratio."
3. The time-temperature curves employed in cooking.

The constituents of the cooking liquor are lime and sulphur dioxide, and the relative amounts of these normally present are such that the solution is one containing both sulphurous acid and calcium bisulphite. The terms commonly used in the industry in reporting the composition of the acid are "total SO_2," "free SO_2," and "combined SO_2." The "combined" SO_2 is the quantity stoichiometrically required for combination as monosulphite with all the lime present. The so-called "free" SO_2 is the difference between this and the "total" SO_2 as determined by titration with iodine. Since, however, the lime present exists and behaves as bisulphite, the term "free," as applied to the SO_2 in excess of that required by the lime as monosulphite, is rather a misnomer, and throughout this work the SO_2 present in excess of that required by the lime as bisulphite, and not as monosulphite, is considered to be the free or uncombined SO_2, but the term "excess SO_2" is used to designate this quantity. The term "combined SO_2" is retained and the values given are accordingly one-half the SO_2 actually combined with base as bisulphite, this being the general usage of the term in the industry.

In studying the effect of variations in liquor composition then, the factors that have to be varied independently are quantity and concentration of excess SO_2 and of bisulphite.

CONCLUSIONS.

Variation of excess SO_2 has less effect upon yield and purification when concentration of bisulphite is low than when high. It has a greater effect with wet wood than with dry. When it is desired to increase the cooking rate it is better, where practicable, to increase the excess SO_2 than to reduce the concentration of bisulphite.

Duration of Cooking.—Increasing the cooking time improves bleachability, but at the expense of yield and strength. Nevertheless, the results of this series of tests show that ten hours is required with the type of cook employed for the production of pulp sufficiently white for use in newsprint without bleaching.

The Liquor Ratio should be as low as is consistent with covering of the chips from the commencement of cooking. The higher the liquor ratio for a given lime charge, time-temperature curve, and concentration of excess SO_2, the softer and weaker the pulp and the greater the tendency to redden.

Effect of Varying Concentration of Lime (or Bisulphite).—Changes in bisulphite concentration can be made in two ways—variation of liquor ratio with lime ratio constant, and variation of lime ratio with liquor ratio constant. The effect of the first is referred to in the preceding paragraph. The effect of reducing the lime ratio with the liquor ratio constant has only a slight effect upon yield when the purification is already high, but rapidly reduces the strength. When the degree of purification is not already high the yield is reduced, the purification improved, and the strength lowered as the bisulphite concentration is decreased.

The lime requirements for a given degree of purification are greater for higher temperatures than for lower. The use of less than 6 per cent. lime is dangerous in cooks lasting eight tours or longer and finishing at or above 135 deg. C. maximum temperature. Best results are obtained when 7 per cent. of lime is used and the concentration of bisulphite is equivalent to about 1.6 per cent. combined SO_2. This applies both to quick cooks for strong pulp and longer cooks for easy-bleaching or light-coloured news-grade pulps.

Sugar formation varies with the concentration of bisulphite and for a given time-temperature curve is practically independent of initial excess SO_2, provided this is high enough to give the working pressure of the digester when cooking is proceeding vigorously ;it is infinenced less by the lime ratio than by its concentration as bisulphite; in other words, it is a simple function of hydroen-ion concentration.

EFFECT OF VARIATION IN TIME-TEMPERATURE CURVES.

General.—The series of experiments on gumtop (*E. delegatensis*) carried out in in 1925-26 ,the data from which are summarised above, showed that pulp of moderate strength coupled with comparative ease of bleaching would be obtained by cooking with 7 : 1 liquor ratio for eight hours with 7 per cent. lime and 3 per cent. excess SO_2. The effect of reducing the liquor ratio to 5 : 1, *i.e.*, the minimum requirement of eucalyptus wood, has been noted, the prin-

cipal result being a decrease in the bleachability. With a view to ascertaining the differences, if any, that might exist between *E. delegatensis* and another important species, *E. obliqua* (stringybark) the latter was cooked under the same conditions as cook 132. The result was a well-separated pulp almost free from coarse shives and uncooked wood, and the net yield was 38 per cent. better than gumtop, *i.e.*, 55.6 per cent, compared with 41 per cent. Moreover, the pulp was easier bleaching, and possessed considerably better tearing strength and greater opacity. A check on moist wood, cook 139, gave a pulp that was even better separated, slightly easier-bleaching, and somewhat stronger; the yield was practically the same. A further check, cook 167, made nine months later on dry-stored chips, gave a slightly lower result, 53.6 per cent. The colour of the pulp from these cooks on *E. obliqua* was of a high order, and considered to be sufficiently white for use in newsprint without bleaching. Thus one of the principal problems with which the investigation had to deal was soved—the cost of bleaching could be eliminated. It now remained to determine whether the cost could be still further reduced by decreasing the cooking time without detriment to the quality of the pulp produced. The previous work on *E. delegatensis* had already covered the range of controllable variable factors with the exception of a comprehensive study of time-temperature cooking curves, and this was undertaken next.

CONCLUSIONS IN REGARD TO NEWS-GRADE SULPHITE.

The influence of the most important factors involved in snlphite cooking of the principal types of eucalypt having been investigated, the conclusions reached in regard to the production of news-grade pulps from the light-coloured eucalypts are as follow :—

1. The most satisfactory cooking liquor is one containing approximately 1.6 per eent. of combined SO_2 and 3 per cent. excess SO_2. The volume used shoud be as nearly as possible 1,000 Imperial gallons per ton of 2,000 lb. of chips (oven-dry basis).

2. Several cooking curves are available for the production of first quality news-grade pulp, but just as good pulp for this purpose can be made in five and a half or six hours as in twelve.

GENERAL NOTES.

SAFEGUARDING OF KEY INDUSTRIES.

POTASSIUM XANTHOGENATE ("XANTHATE").

A representation has been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding potassium xanthogenate (" Xanthate ").

Section 10 (5) of the Fiuance Act, 1926, is as follows :—

" The Treasury may by order exempt from the duty imposed by section one of the *Safeguarding* of Industries Act, 1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication on the matter should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, London, S.W.1., within one month from the date of this notice.

CANADA'S TRADE WITH THE UNITED STATES.

The Dominion Bureau of Statistics, Ottawa, has recently issued a summary of the trade of Canada with the United States, which shows that, during October last, imports for consumption from the United States amounted in value to 74,040,646 dollars, while Canadian exports to the United States totalled 47,515,005 dols. The totals for the twelve months ended 81 October last were 805,482,277 dols., and 492,582,966 dols. respectively.

HAGUE INDUSTRIAL PROPERTY CONVENTION.

USE OF NATIONAL EMBLEMS AS TRFDE MARKS : NOTIFICATION BY GERMANY.

In accordance with the provisions of paragraph 3 of Article 6 ter of the Hague Industrial Property Convention of 1925, the German Government has forwarded copies of a publication containing a list of Arms and Flags of the German Empire and the German Federated States which that Government desires to place under the pro-

tection of Article 6 ter of the Convention.

A copy of this publication may be consulted in the Public Library of the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C.2.

Copies of the Convention Treaty Series No. 16 (1928)—may be obtained, price 9d. net, from H.M. Stationery Office at the usual addresses, or through any bookseller.

AUTHORITY BEHIND SMOKELESS FUEL.

Changing Attitude of Experts and Public.

To show the growing appreciation by fuel experts, health organisations, and the public generally of solid smokeless fuel as a factor in domestic smoke abatement a booklet in which are assembled the views of a great variety of authorities published during the past twelve months has been prepared and circulated to Members of Parliament and to gas and colliery companies.

The compilers of the booklet (Low Temperature Carbonisation, Ltd., owners of the British Parker system) attribute this conversion primarily to the convincing proof that has been placed before responsible medical and administrative authorities that the solid smokeless fuel from low temperature carbonisation not merely fulfils every requirement for the solution of the domestic smoke problem, but also has reached that stage of practical commercial production when it can be seriously recommended for adoption by municipalities, gas concerns and colliery companies."

The booklet gives many instances of definite action by local authorities, Medical Officers of Health, Regional Smoke Abatement Committees and other societies interested in the prevention of atmospheric pollution to encourage the use of British smokeless fuels now on the market.

Municipal officials, medical officers, and officials of gas and colliery concerns may obtain copies free from Low Temperature Carbonisation, Ltd., Coalite House, 28, Grosvenor Place, S.W.1.

MINERAL RESOURCES OF SASKATCHEWAN.

The greatest natural resource of Saskatchewan is undoubtedly the top six inches of soil found on the 70,000,000 acres of agricultural land which lies within the boundary of the Province, producing field crops, livestock and other farm products of an annual value exceeding $400,000,000.

Nevertheless, the geological features of this Province, now primarily agricultural, may be divided into two great divisions of amost equal area. The northern half is referred to as the Laurentian Plateau, or rock formation. The southern half comprises the Great Plains, region, a sedimentary formation containing clays, sandstone, coal, etc.

Coal.

Chief among Saskatchewan's mineral resources now in process of development are the vast deposits of lignite coal found mostly in the southern portion of the Province. In the matter of her coal resources Saskatchewan ranks third among the Provinces of the Dominion, the total volume having been estimated at no less than 50,000,000,000 tons. The chief output comes from the vicinity of Estevan, where very modern and fully equipped mines are in operation. Many small mines supplying local domestic demands are in operation over a wide area in southern Saskatchewan, extending from Estevan to Eastend. The seams mined vary from five to fifteen feet, and all lie within 200 feet of the surface. In one mine a steam shovel is being operated.

This coal is all lignite, which at present is difficult of utilisation, containing as it does 30 per cent. of moisture. The industry expects to benefit immensely from the application of carbonising and briquetting processes, and if these can be put into general commercial practice, as is now anticipated, the coal situation in Saskatchewan will very greatly improve, and the vast field of lignite now considered of secondary value will become an important source of wealth to the Province. There are also great possibilities in the conversion of coal into electricity at power plants located at the pit mouth.

Clay.

The clay deposits in the Province are practically unlimited and supply raw material for a great variety of products, such as china, porcelain, general white ware, glazes, refractors, and some are suitable for paper filler. There are very large deposits of this class in southern Saskatchewan, especially in the Readlyn-Willows district, the Dirt Hills, along Big Muddy Lake and nearby territory. These semi-china or ball clays are exceptionally important as they are not found elsewhere in the Dominion and are necessary in the manufacture of so many of the high-class wares. There also fire clays of highly refractory characteristics, which are used in the manufacture of firebrick, flue and furnace lining, locomotive arch tile, tractor block and other articles.

Mining operations on these large deposits of highly valuable clays are carried on at Claybank and Willows. It might be of interest here to point out that high-grade refractory clays are not common elsewhere in the Dominion. The Saskatchewan clay plant now supplies locomotive arch tile to the railway companies who formerly had to import their requirements in this material from the United States.

Pottery clays, with buff burning, refractory and plastic characteristics, suitable for yellow ware, stone ware, terracotta, and other porcelains in daily domestic use, are found at Eastend, Willows, Big Muddy and elsewhere. One particular clay of this nature in the Eastend field compares favourably with the best pottery clays found anywhere in the world. Common brick and structural clays, of which there are unlimited quantities found over a wide area, are used as structural material, such as brick and tile, fireproofing, paving brick, sewer pipe, terra-cotta, red ware pottery.

Glass Sand and Oil Shales.

Important deposits of exceptionally pure glass sand occur on the south shore of Wapawekka Lake, and low-grade oil shales occur in the Pasquia Hills and south of Lac la Ronge.

Tar sands similar to those of Northern Alberta have been located in the vicinity of Buffalo Yake, northwest of Ile à la Crosse, but no information is as yet available as to the exact location or the extent of these deposits.

Of the other minerals found in southern Saskatchewan the most important is sodium sulphate, of which more than 200 known deposits exist. About 20 of the larger deposits already mapped contain 100,000,000 tons, Aside from the medicinal uses of sodium sulphate it is used in the manufacture of kraft paper and glass. Development of this manufacture has so far been rather slow and is more or less in an experimental stage. Three plants have been operating, and the production of these plants in 1927 totalled 5,659 tons.

Large deposits of volcanic ash have been located at Swift Current, Gull Lake and St. Victor. The commercial use for this mineral is in polishes and cleansers, and the production in 1927 was 105 tons. This ash has been shipped out of the Province and there is a growing demand for the product.

Bentonite is found at Eastend and St. Victor, and is used as a filler material for paper, rubber soap, face cream, and also as a clarifier for oils.

Various Minerals.

The great mineralised area, or the northern half of the two geological divisions, better known as the pre-Cambrian, occupies more than 80,000 square miles and is approximately one-third of the total area of the Province. The following minerals have been found in the pre-Cambrian of northern Saskatchewan :— Copper-zinc ore, Flin Flon; copper-sulphide ore (chalcopyrite), Las la Ronge; copper-lead-zinc ore, Reindeer Lake; iron ore (hematites and Limonites), Lake Athabasca; Iron ore (magnetite), Churchill River; pyrites (iron sulphide), Lac la Ronge; gold quartz, Beaver Lake; talc schists, Wapawekka Lake; nickel iron, Churchill River. These minerals all represent commercial possibilities. Other minerals have been found. It is for the future to determine what this great treasure house may have locked up in its vaults for future generations.

Power Resources.

Whatever the mineral deposits may be, there is both ample and cheap power for their development. The Dominion Government has estimated the horsepower at approximately 1,000,000 on the Churchill and its tributary waters, more than double the requirements of all the mines under operation in the Dominion at the present time. Thirty thousand horsepower at Island Falls is now being developed for use at the Flin Flon mines in Manitoba and surrounding territory. The Government of Saskatchewan has reserved one-sixth of this power for such immediate development of mining as may take place at or near this power site.

CANADIAN MINERAL PRODUCTION, 1928.

The total estimated mineral production for the calendar year 1928 is likely to reach $100,000,000 as compared with the final statistics for 1927, which totalled $90,283,447. Of the estimated total production for 1928 $69,000,000 is expected to be contributed by metals; $7,500,000 by non-metals; and $23,500,000 by structural materials and clay products.

Gold mining, despite important gains in the Kirkland Lake district, has shown a slight decrease during the nine months due to curtailed operations at the Hollinger mine—where the grade of ore and tonnage milled fell off during the period. The production of silver has continued to decline, due principally to the depletion of the mines. Nevertheless, production from the present mines is expected to continue for a

number of years. The nickel-copper industry continued to prosper, and not since 1918 has such great progress been shown as in the current year.

CANADIAN PETROLEUM PRODUCTION.

According to finally revised figures just issued by the Dominion Bureau of Statistics at Ottawa, the 1927 production of petroleum amounted to 476,591 barrels, valued at $1,516,043 as compared with 364,444 barrels worth $1,311,665 produced in the previous year.

Capital employed in the operation of oil wells in Canada during 1927 totalled $22,773,916. Salaried employees and wage-earners numbered 781; the earnings of these employees amounted to $1,120,224. Fuel and electricity cost $112,763. Primary power employed consisted of 111 units having a total rating of 3,364 h.p., in addition to which 81 electric motors rated at 768 h.p. were in use.

THE BRITISH METAL CORPORATION, LIMITED.

Sir Cecil L. Budd, K.B.E., is relinquishing, at the end of this year, the office of managing director of The British Metal Corporation, Limited, which he has held jointly with Captain Oliver Lyttelton. He will retain his seat on the Board and will continue to act as Chairman of the Management Committee.

LIEBIG'S EXTRACT OF MEAT COMPANY, LIMITED.

Subject to confirmation at the Ordinary General Meeting of the Company a final dividend of nine shillings per share, free of income tax, on the old Ordinary Shares Nos. 1 to 800,000 in respect of the year ended 31 August, 1928, will become payable on and after 23 January next, to the proprietors of Ordinary Shares registered on the Company's books on the 10th January. In respect of Coupon No. 91 of the Ordinary Share warrants to bearer such dividend will become payable on and after 23 January next at the Company's bankers, Messrs. Glyn, Mills & Co., 67, Lombard Street, London, E.C.3. Coupons must be left for examination three clear days before payment. Coupons may also be presented in Antwerp at the Banque Centrale Anversoise for payment at the short exchange on London.

STUDIES OF THE GALACTIC CENTRE. THE PROGRAMME FOR MILKY WAY VARIABLE STARS.

By Harlow Shapley.
Harvard College Observatory.

(Abstract from *Proceedings of National Academy of Sciences.*)

Ever since the study of the space distribution of globular clusters indicated the eccentric position of the solar system in the Galaxy, I have desired to investigate in detail those distant regions in the southern Milky Way where the centre of the galactic system appears to be. The usual statistical methods of elucidating galactic structure from rather indiscriminate counts of stars and from measures of motions in the solar neighbourhood seem to be too limited—wholly inadequate, in fact, for analysis of regions some twenty thousand to a hundred thousand light years distant. The so-called Kapteyn universe, for instance, is deducted without regard to local clustering, and it combines the data from all galactic longitudes; many earlier attempts to outline the system did not even allow for differences in galactic latitude. The Milky Way system is obviously a conglomerate of single stars, groups of stars, clusters and great star clouds, seriously obscured in certain regions by nebulosity. A direct attack on the problem of the distances of the individual stars in the Milky Way, of the individual nebulæ, and of stellar groups, by methods that reach far and give unambiguous results, appears to be the most satisfactory way of working out the details of galactic dimensions and structure, and in particular of determining the nature of the central regions of the galactic system. The researches undertaken to that end will be reported in a series of notes under the title "Studies of the Galactic Centre," but the more extensive details, especially the observations dealing with variable stars and star counts, will be published mainly in the Bulletins or Circulars of the Harvard Observatory.

As a preliminary, it should be recalled that all the known globular clusters, about a hundred in number, form a unified, considerably flattened system of still higher order, symmetrical with respect to the galactic plane. Their distances range from fifteen thousand to about two hundred thousand light years, and the greatest diameter of the system, in the plane of the Galaxy, is between two hundred thousand and three hundred thousand light years. The centre of the Galaxy is in the direction of galactic latitude 0°, galactic longitude 327°, and it is so remote that a very asymmetrical ap-

parent distribution is imposed on the globular clusters, which thus appear concentrated in Scorpia, Saggittarius, and the surrounding constellations. Also there appears to be a decided concentration of other remote and highly luminous objects in this same region of the sky, probably the result of the great depth of the Galaxy in the direction of the centre, rather than of a real clustering of such objects around the centre.

Since the globular clusters are probably good indicators of the form of the Galaxy, of which they are a part, we conclude somewhat tentatively that galactic objects lie in an irregular circular and much flattened system—a discoidal affair populated by probably not less than 10^{11} stars. Its dimensions may be greater or less than those of the surrounding and concentric system of globular clusters. It is our problem to discover the extent of the Galaxy by direct measurement, instead of contiuuing to base our estimates largely on the distribution of the globular clusters.

Increasing knowledge of the absolute luminosity of variable stars increases also their usefulness in measuring distances, whether inside the Galaxy, or outside, in globular clusters, Magellanic clouds and extra-galactic nebulæ. It now appears that typical Cepheids, cluster type variables, long period variables and to a more limited extent novæ and eclipsing binaries, can all be used in the work on galactic dimensions. Ultimately we may use also the planetary nebulæ, the open clusters, peculiar types of variables, and stars of extraordinary spectrum and colour in this work; and certainly the integrated magnitudes and angular dimensions of globular clusters and extra-galactic nebulæ are among the most potent measuring tools, though they are only indirectly used in the present study of galactic structure.

In order to provide material for the general study of faint variable stars as bearing on the Milky Way problem, an extensive observing programme was inaugurated about five years ago at the Harvard Observatory.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Papers read, December 20:—

Influence of Poles and Polar Linkings on the Course Pursued by Elimination Reactions. Part II. Mechanism of Exhaustive Methylation. By C. K. INGOLD AND C. C. N. VASS.

The theory of Hanhart and Ingold requires, *inter alia*, that the suppression of olefine-formation in favour of methyl alcohol-elimination in the decomposition of $\{CHR^1R^2.CR^3R^4.NMe_3\}OH$ should (*a*) increase, tending towards constancy, with increasing R^1 and R^2, (*b*) be greater when R^1R^2CH; or any part thereof, is branched than when unbranched and isomeric. Requirement (*a*) is verified up to and including hexyl (at which the constant value is reached), and (*b*), which was previously illustrated for *n*- and *iso*-propyl is now confirmed for *n*- and *iso*-butyl.

Influence of Poles and Polar Linkings on the Course Pursued by Emilination Reactions. Part III. A Decomposition of Dialkylsulphones. By G. W. FENTON AND C. K. INGOLD.

The polar linkings in the sulphone group resemble the changed nitrogen in ammonium salts in promoting a decomposition analogous to that of quaternary ammonium hydroxides. The products are an olefine and a sulphinic acid. The rule of preferential elimination of ethylene is obeyed, but owing to the smaller electron-affinity of $.SA_2R$ than of $.NMe_3$ the protective action of alkyl groups attached to the β-carbon atom works more powerfully in the sulphone case.

Researches on Residual Affinity and Coordination. Partr XXXI. Molybdyl bis-β-diketones. By G. T. MORGAN AND R. A. S. CASTELL.

The literature contains references to two molybdenum derivatives of acetylacetone, the molybdous acetylacetone formulated by Gach as $Mo(C_5H_7O_2)_2$ and molybdyl bis-acetylacetone, $MoO_2(C_5H_7O_2)_2$, first prepared by Rosenheim and Berthein (*Z. anorg. Chem.*, 1903, XXXIV, 489). The composition indicated for the former compound is extremely improbable because the method of preparation is very similar to that employed in the production of the latter substance. These two preparations have now been repeated, and the products have been proved to be identical.

The condensation has been proved to be a general reaction by the preparation of other molybdyl bis-β-diketones using such aliphatic diketones as propionyl-acetone, dipropionylmethane and γ-ethylacetylacetone and also with benzoylacetone and dibenzoylmethane containing aromatic radicals. The products in all cases are compounds containing sexavalent molybdenum. A hydrated molybdenyl acetylacetone, $MoO.C_5H_7O_2$, $2\frac{1}{2}H_2O$, with the metal in a lower state of oxidation, was obtained by using the recently prepared molybdenyl chloride.

Interactions of Selenium Oxychloride and Phenols. By G. T. MORGAN AND F. H. BURSTALL.

It was formerly stated by Michaelis and Kunckell (*Ber.*, 1897, xxx, 2824) that phenol and β-naphthol reacted with selenium oxychloride to form selenides of the type $Se(R.OH)_2$, R being C_6H_4 or $C_{10}H_6$, and that resorcinol yields a selenyl derivative $SeO\{C_6H_3(OH)_2\}_2$.

A revision of these condensations has now shown that only in the case of β-naphthol is the selenide isolated.

Phenyl and selenium oxychloride furnish two isomeric trihydroxytriphenylselenonium chlorides, $[(HO.C_6H_4)_3Se]Cl$, which are binary electrolytes containing ionisable chlorine replaceable by other acidic radicals. The complex cation includes three phenolic hydroxy-groups which confer acidic properties on these salts so that they dissolve in aqueous alkali hydroxides and these alkaline solutions when neutralised deposit the amphoteric oxides, $[(HO.C_6H_4)_2Se]_2O$, as amorphous white precipitates.

The results indicate that between selenium oxychloride and the phenols two modes of interaction may take place, one manifested by phenol and resorcinol :

$$3RH.OH+SeOCl_2=(HO.R)_3Se.Cl+HCl+H_2O$$

and another exemplified by β-naphthol and salicylic acid :

$$3RH.OH+SeOCl_2=Se(R.OH)_2+RCl.OH+HCl+H_2O.$$

With *o*- and *p*-cresols both interactions occur concurrently.

Influence of Poles and Polar Linkings on Tautomerism in the Simple Three-Carbon System. Part I. Experiments Illustrating Prototropy and Anionotropy in Trialkylpropenlyammonium Derivatives. By C. K. INGOLD AND E. ROTHSTEIN.

Trimethyl- and triethyl-γ-chloro-Δ^{β}-propenylammonium salts are readily transformable into corresponding Δ^{α}-salts, in which the γ-chlorine atom is replaceable, but in the α-position, by competing anions (Burton), giving another series of Δ^{β}-salts. Trimethyl- and triethyl-α-ethoxy-Δ^{β}-propenylammonium salts are characterised by the ease with which the cation undergoes hydrolysis with acids and by the difficulty which attends the replacement of ethoxyl by halogen. The same is true of α-ethoxy-α-aldehydotetramethylammonium salts — two series which were encountered during the determination of the constitutions of the various unsaturated salts by ozonolysis. An explanation of these observations is suggested.

The arachor and Chemical Constitution. Part X. Singlet Linkings in Chelated Co-ordination Compounds. By S. SUGDEN.

The parachors of a number of thallium, beryllium, and aluminium derivatives of β-diketones have been determined and show the negative anomalies predicted for the singlet linkings in the structural formulæ suggested for these substances (Sugden, 1927, 1179). Basic beryllium propionate and aluminium bromide are also found to contain singlet linkings and structures for these compounds are suggested which account simply for the observed parachors.

An alternative hypothesis, which can account for these negative anomalies without using singlet linkings, has been examined, and is shown to be incompatible with the data for mercury and thallium compounds. The presence of singlet linkings is at present the only hypothesis which gives a simple explanation of the parachor anomalies.

The free β-diketones and certain derivatives which have hitherto been assigned a cyclic co-ordinated structure are shown to ossess an open chain structure.

The following atomic parachors have been determined Hg=69, Tl=62, Pb=76, Be=38, Al=39.

THE ROYAL INSTITUTION.

On Tuesday next, January 15, at 5.15, Dr. F. A. Freeth will begin a course of two lectures at the Royal Institution on " Critical Phenomena in Saturated Solutions," and on Thursday, January 17, Major Gordon Home delivers the first of two lectures on " Roman London." On Saturday afternoon, January 19, at 3 p.m., Dr. Emile Cammaerts will commence a course of three lectures on " Flemish and Belgian Art." The Friday Evening Discourse on January 18 will be delivered by Sir Willilam Bragg, on " Further Progress in Crystal Analysis," and on January 25 by Professor A. C. Seward on " The Vegetation of Greenland."

CORRESPONDENCE.

CARBON MONOXIDE DANGER.

To the Editor of the CHEMICAL NEWS.

SIR,—During the last few days there have been three tragic deaths of maidservants—two in Hastings and one in Berkshire—all stated to have been due to carbon monoxide poisoning, the gas having been emitted into rooms almost devoid of ventilation.

Carbon monoxide is, as you are aware, a product of combustion of all fuels including ebery kind of coal, coke, wood, ordinary

domestic gas and commercial petrol, and it would be wrong to attribute a greater danger from this gas to any one of these fuels more than to another.

The accident at Hastings is stated to have resulted from a down draught in a flue which led to the fireplace of the maids' bedroom, the flue being connected with an outside pipe which in turn was connected with an anthracite stove. The maids' room was for all practical purposes, hermetically sealed, the windows and doors being closely fastened. The outside iron flue was in itself an unsuitable means of carrying away the products of combustion; and it led into a cold brick flue in which there was no warm updraught to ensure a clearance of these products in the abnormal weather conditions prevailing. Had the stove been directly connected with one of the ordinary chimneys of the house, no danger would have arisen, as the ordinary brick or stone flue is absorbent of heat and the passage of the combustion products to the outside atmosphere would thereby have been facilitated.

In the case in Berkshire, the tragedy is attributed to carbon monoxide fumes resulting from the burning of coke and the jury recommended in this case that the ventilation which was inadequate, should be improved.

Some years ago at Leighton Buzzard two deaths resulted from carbon monoxide poisoning where the gas was emitted into the room from an ordinary coal fire burning in an open grate, and here again insufficient ventilation of the room was largely responsible.

Cases arise from time to time of carbon monoxide poisoning resulting from ordinary domestic gas, and it would therefore be unreasonable and not in accordance with fact to lay the blame on any particular fuel.

In connection with the case at Hastings it is stated that no similar fatality has arisen in connection with an anthracite-burning stove for the past 50 years and in view of the very large number of anthracite-burning stoves in use in this country and their general use for domestic heating on the Continent and in Canada and the United States, there is abundant proof of their absolute safety when properly fitted to one of the ordinary chimneys of the house.

The facts of these cases demonstrate very clearly how essential it is to provide proper ventilation in all rooms—particularly in small rooms—where heating appliances are likely to affect the atmosphere, and it is safe to say that not one of these accidents would have happened if some attention had been paid to proper ventilation, for no matter what the fuel in use may be, the products of combustion must be afforded a proper means of exit.

In the construction of the modern anthracite stove particular attention has been given to ensure that the products of combustion are freely conveyed from the stove through the chimney to the outside atmosphere, and provided the stove is fitted in accordance with the directions of the makers, there is no danger whatsoever.

Yours faithfully,

A. W. Cope.

Forthcoming Events.

THE ROYAL SOCIETY.

Thursday, January 17, at 4.30 p.m.—The following papers will be read :—

"The Charge of an Electron." By A. S. Eddington, F.R.S.

"The Thermionic Emission Constant A." By R. H. Fowler, F.R.S.

"The Triplets of Helium." By J. A. Gaunt. Communicated by R. H. Fowler, F.R.S.

"The Tensorial Form of Dirac's Wave Equations." By G. Temple. Communicated by S. Chapman, F.R.S.

The following papers will be read in title only :—

"The Reflexion and Transmission of Electric Waves at the Interface between two Transparent Media." By H. M. Macdonald, F.R.S.

"On the Analysis of the First Spark Spectrum of Sulphur. By D. K. Bhattacharyya. Communicated by M. N. Saha, F.R.S.

"The Pressure of Gaseous Mixtures II. By C. W. Gibby, C. C. Tanner, and I. Masson. Communicated by F. G. Donnan, F.R.S.

"Effect of Combined Electric and Magnetic Fields on the Helium Spectrum." By J. S. Foster. Communicated by A. S. Eve, F.R.S.

"The Ultra-Violet Spectrum of Magnesium Hydride. I." By R. W. B. Pearse. Communicaed by A. Fowler, F.R.S.

"Patterns and Paschen-Back Analogue in the Stark Effect for Neon." By J. S. Foster and W. Rowles. Communicated by A. S. Eve, F.R.S.

"Stark Effect in a Violet Region of the Secondary Spectrum of Helium." By J. K. L. MacDonald. Communicated by A. S. Eve, F.R.S.

"Relative Intensities of Stark Components in Hydrogen. By J. S. Foster and M. L. Chalk. Communicaed by A. S. Eve, F.R.S.

"Some Experiments Concerning the Counting of Scintillations Produced by Alpha-Particles. Part I. Part I.—The Determination of the Efficiency of Transformation of Kinetic Energy of the α-Particles into Radiant Energy. Part III. Practical Applications." By J. Chariton and C. A. Lea. *Communicated* by J. Chadwick, F.R.S.

"The Relativity Theory of Divergent Waves." By O. R. Baldwin. Communicated by G. B. Jeffery, F.R.S.

"*The Thermal Conductivity* of Solid and Liquid Sulphur." By G. W. C. Kaye and W. F. Higgins. Communicated by Sir Joseph Petavel, F.R.S.

"On Bromine Chloride." By S. Barrett and C. P. Stein. Communicated by T. R. Merton, F.R.S.

MINERALOGICAL SOCIETY.

The next meeting of the Society will be held (by kind permission) in the apartments of the Geological Society of London, Burlington House, Piccadilly, on Tuesday, 15 January, at 5.30 p.m.

Papers to be read :—

"The Tholeiite Dikes of the North of England." By Prof. Arthur Holmes, and Dr. H. F. Harwood.

"On the Occurrence of Gold at Hope's Nose, Torquay, Devonshire." By Mr. Arthur Russell.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

The Annual Meeting of the Society will be held in the Lecture Hall at the above address on Wednesday, January 16, at 7.45 p.m., for 8 p.m., when the election of Officers and Council for the ensuing year and other business will be taken. Mr. Joseph E. Barnard, F.R.S., F.Inst.P., P.R.M.S., will deliver the Presidential Address : "Some Aspects of Ultra-Violet Microscopy."

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

Tuesday, January 15, at 5.15 p.m.—Dr. F. A. Freeth : "Critical Phenoment in Saturated Solutions."

Thursday, January 17, at 5.15 p.m.—"Roman London." By Gordon Home.

Friday, January 18, at 9 p.m.—Sir William Bragg, K.B.E., D.Sc., F.R.S., M.R.I., Fullerian Professor of Chemistry : "Further Progress in Crystal Analysis."

Saturday, January 19, at 3 p.m.—"Flemish and Belgian Art—The Portrait." By E. Cammaerts.

ROYAL SOCIETY OF ARTS.

ARRANGEMENTS FOR MEETINGS DURING JANUARY, 1929.

Wednesday, January 16, at 8 p.m.—(Ordinary Meeting). Professor Charles R. Darling, A.R.Sc.I., F.I.C. : "The Domestic Smoke Problem—A Practical Solution."

Monday, January 21, at 8 p.m.—(Cantor Lecture.) C. H. Lander, C.B.E., D.Sc., M.Inst.C.E., F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research : "The Treatment of Coal." (Lecture I.)

Wednesday, January 23, at 8 p.m.—(Ordinary Meeting). Sir Henry A. Miers, F.R.S. : "Museums and Education." The Right Hon. the Earl of Crawford and Balcarres, K.T., P.C., LL.D., F.R.S., P.S.A., will preside.

Monday, January 28, at 8 p.m.—(Cantor Lecture). C. H. Lander, C.B.E., D.Sc., M.Inst.C.E., F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research : "The Treatment of Coal." (Lecture II.)

Wednesday, January 30, at 8 p.m.—(Ordinary Meeting.) George Fletcher : "The Shannon Scheme and Its Economic Consequences."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

37,513.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of synthetic rubber. December 20th.

37,925.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of motor fuels. December 12th.

37,473.—Jones, H. E.—Method of obtaining ammonia. December 19th.

37,851.—Rowell, S. W. — Concentrated acetic acid. December 18th.

37,798.—Soc. Anon. Distilleries des Deux-Sevres.—Separation of anhydrous acetic acid. December 21st.

Specifications Published.

302,253.—Johnson, J. Y.—*Manufacture and production of valuable hydrocarbons.*

302,191.—Imray, O. Y.—Manufacture of ethers of carbohydrates.

273,684.—Chemische Fabrik auf Actien (Vorm. E. Schering).—Process for the manufacture of condensation products from m- and p-cresol and diliphatic ketones.

273,686.—Chemische Fabrik auf Actien (Vorm. E. Schering).—*Process for the manufacture of alkylisopropylenephenols, and alkylated cumaranes.*

274,439.—Chemische Fabrik auf Actien (Vorm. E. Schering).—Process for masufacture of alkylated phenols and their hydrogenated products.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

STEAREX.

494,996.—Chemical substances used in manufactures, photography or philosophical research, and anticorrosives.—*Binney & Smith Company, 41, East 42nd Street, City and State of New York, United States of America.* December 26th.

TROGET.

496,641.—Chemical substances prepared for use in medicine and pharmacy.—Henry Edward William Gort, 241, Victoria Park Road, South Hackney, London, E.9. December 26th.

FULDISIT.

497,212.—Chemical substances prepared for use in medicine and pharmacy.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. December 26th.

AVOGLOSS.

497,128.—Chemical substances used in manufactures, photography or philosophical research, and anticorrosives.—C. R. Stevens & Sons, Ltd., Avondale Works, Cocklebury Road, Chippenham, Wiltshire. December 26th.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the *curriculum.*

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : Merton House, Salisbury Sq.. London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.
16, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL CXXXVIII. No. 3588.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES :

Administrative : Central 6521.

Printing Works : Hop 2404.

CONTENTS. PAGE.

Professor Eddington on the Wonder World ... 33
By F. H. Loring.
Industry and Smoke Abatement ... 35
The Aurora Red Line ... 36
By Joseph Kaplan.
The Forests of Sweden ... 37
General Notes ... 39
Modern Swimming Bath Operation ... 39
By A Well-Known Engineer.
Wave Lengths and Zeeman Effects in Yttrium Spectra ... 40
By William F. Meggers.
Eastern Canada's Chemical Industries 41
An Important British Development in Thermal Storage ... 43
Proceedings & Notices of Societies :—
Geological Society of London ... 45
Notices of Books ... 46
Forthcoming Events ... 47
New Patents ... 47
New Trade Marks ... 48

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

PROFESSOR EDDINGTON ON THE WONDER WORLD.

THE NATURE OF THE PHYSICAL WORLD, by A. S. Eddington, F.R.S. — London : Cambridge University Press, Fetter Lane, E.C.4.; pp. xix + 360; price 12s. 6d.; 1928 —embodies the Gifford Lectures. These lectures are required to be of a popular nature free from mathematics.

We have before us a book of remarkable charm. Professor Eddington illuminates some of the dark corners of physics and chemistry with a light that is not too glaring for the eyes and so enables those of weaker sight to see the deeper meaning of phenomena.

As this book should appeal to many readers, the following is a list of the subjects touched upon deeply, and we may say accurately in so far as is permitted by the present state of knowledge :—Structure of the Atom; Fitzgerald Contraction; Frames of Space; Relativity; Downfall of Classical Physics; Velocity of Light; Time and Space and Events; Four-Dimensional World; Running Down of the Universe; Second Law of Thermodynamics; Thermodynamical Equilibrium; Infinity of Space and Time and the Relativity View; Entropy; Dual Recognition of Time; Gravitation; Einstein's Law of Motion; Relativity of Acceleration; Geometry and Mechanics; Law of Curvature; Relativity of Length; Non-Empty Space; Non-Euclidean Geometry; Man's Place in the Universe; Plurality of World's; Formation of the Planetary System; Quantum Theory; Nature of h, Atom of Action; Conflict with the Wave Theory; Relation of Classical Laws to Quantum Laws; Bohr's Correspondence Principle; Quantum Numbers; New Quantum Theory; Wave Theory of Matter; The Wavicle; Three New Theories; Dirac's p's and q's; Schrödinger's Theory; Principle of Indeterminacy; World Building; Identical Laws; Selective Influence of the Mind; Three Types of Laws; Pointer Readings; Cyclic Method of Physics; Actuality; Reality; Mind-Stuff; Causation; Causation and Time's Arrow; New Epistemological Outlook; Physics Drifting away from Predetermination; Natural and Supernatural;

WANTED, *Chemical News* issue for January 6th, 1928, clean for binding.— Reply to G. E. Stechert & Co., 2, Star Yard, London, W.C.2.

Volition; Mind and Statistical Laws; Science and Mysticism; Symbolic Knowledge and Intimate Knowledge; Defence of Mysticism; Mystical Religon.

A few titles have been added and some omitted, but the above list will give the reader an idea of the scope of the book.

Various extracts have been selected to show the style of the book with particular reference to subjects of topical interest. On page xv we read— "Until recently there was a much closer linkage; the physicist nsed to borrow the raw material of his world from the familiar world, but he does so no longer. His raw materials are æther, electrons, quanta, potentials, Hamiltonian functions, etc., and he is nowadays scrupulously careful to guard these from contamination by conceptions borrowed from the outer world. . . . After the physicist has quite finished his world-building a linkage or identification is allowed; but premature attempts at linkage have been found to be entirely mischievous." Some will not quite agree here, but whatever their opinion may be they must reckon with the new ideas and entities (such as electrons) of chemistry and physics.

On page 54 we read of the velocity of light which as a basic constant in the theory of relativity has no doubt puzled many. Prof. Eddington says :—" A feature of the relativity theory which seems to have aroused special interest among philosophers is the absoluteness of the velocity of light. In general velocity is relative . . . but it is a curious fact that if I speak of a velocity of 299796 kilometres a second it is unnecessary to add the explanatory phrase. Relative to what? . . . Let us take our favourite observer who travels at 161,000 miles a second *and send him in pursuit of the flash of light.* It is going 25,00 miles a second faster than he is; but it is not what he will report. Owing to the contraction of his standard scale his miles are only half-miles; owing to the slowing down of his clocks his seconds are double seconds. His measurements would therefore make the speed 100,000 miles a second (really half-miles per double-second). He makes a further mistake in synchronising the clocks with which he records the velocity . . . This brings the speed up to 186,000 miles a second. From this point of view the traveller is lagging hopelessly behind the light; he does not realise what a close rase he is making of it, because his measuring appliances have been upset. You will note that the evasiveness *of the light-flash is not in the least analogous to the evasiveness of the rainbow.*"

On page 74 Prof. Eddington says :—" The practical measure of the random element which can increase in the universe but can never decrease is called *entropy.* Measuring entropy is the same as measuring by the chance explained in the last paragraph, only the unmanageably large numbers are transformed (by a simple formula) into a convenient scale of reckoning . . . The law that entropy always increases—the second law of thermodynamics—holds, I think, the supreme position among the laws of nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations—then so much the worse for Maxwell's equations. *If it is found to be contradicted* by observation—well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation. This exaltation of the second law is not unreasonable. There are other laws which we have strong reason to believe in, and we feel that a hypothesis which violates them is highly improbable; but the improbability is vague and does not confront us as a paralysing array of figures, whereas the chance against a breach of the second law (*i.e.*, against a decrease of the random element) can be stated in figures which are overwhelming."

On page 198 Prof. Eddington attempts a picture of the atom as revealed by the new quantum theory. " For example I will borrow a quantum conception from the next chapter [The Quantum Theory]. It may not be destined to survive in the present rapid evolution of ideas, but at any rate it will illustrate my point. In Bohr's semi-classical model of the hydrogen atom there is an electron describing a circular or elliptic orbit. This is only a model; the real atom contains something which it has not entered into the mind of man to conceive, which has, however, been described symbolically by Schrödinger. This ' something ' is spread about in a manner by no means comparable to an electron describing an orbit. Now excite the atom into successively higher and higher quantum states. In the Bohr atom the electron leaps into higher and higher orbits. In the real atom Schrödinger's ' something ' begins to draw itself more and more together until it begins sketchily to outline the Bohr orbit and

even imitates a condensation running round. Go on to still higher quantum numbers, and Schrödinger's symbol now represents a compact body moving round in the same orbit and the same period as the electron in Bohr's model, and moreover radiating according to the classical laws of an electron. And so when the quantum number reaches infinity, and the atom bursts, a genuine classical electron flies out. The electron, as it leaves the atom, crystallises out of Schrödingers mist like a genie emerging from his bottle."

Speaking of de Broglie's contribution to the wave-theory of matter, Eddington, on page 201, says :—" Light, we will say, is an entity with the wave property of spreading out to fill the largest object glass and with all the well-known properties of diffraction and interference; simultaneously it is an entity with the corpuscles or bullet property of expending its whole energy on one very small target. We can scarcely describe such an entity as a wave or as a particle; perhaps as a compromise we had better call it a " wavicle '."

On page 220 we read :—" *A particle may have position or it may have velocity but it cannot in any exact sense have both.*" This means evidently that what is lost on the swings is gained on the roundabouts, or *vice versa*, referring to a loss of accuracy or definiteness, and this is the *principle of indeterminacy*. As we probe deeper into the Phenomena of the world, into the small world of the atom affairs seem to take on new aspects and this introduces new conceptions into physics.

The mystery deepens as may be judged by quoting from page 291,

" The slithy toves
Did gyre and gimble in the wabe,"

suggesting here *activity*, so by " admitting a few numbers [it must be remembered that our science is built up of numbers] even ' Jabberwocky ' may become scientific. We can now venture a prediction; if one of its toves escapes, oxygen will be masquerading in a garb properly belonging to nitrogen. In the stars and nebulæ we do find such wolves in sheep's clothing which might otherwise have startled us. It would not be a bad reminder of the essential unknownness of the fundamental entities of physics to translate it into ' Jabberwocky '; provided all numbers—all metrical attributes—are unchanged, it does not suffer in the least. Out of the numbers proceeds that harmony of natural law which it is the aim of science to disclose. We can grasp the tune but not the player. Trinculo might have been referring to modern physics in the words, ' This is the tune of our catch, played by the picture of Nobody '."

This book abounds in finely cut phrases and clearly crystallised thoughts, so that it would be of great use to authors wishing to adorn their chapters with apt quotations.

In conclusion, the book is eminently practical; and, strange as it may seem, to many it will no doubt be regarded as a work of considerable utility. To achieve this end without mathematics is certainly a great accomplishment, but only a master mind could do it.

F. H. L.

INDUSTRY AND SMOKE ABATEMENT.

F.B.I. Warning to Manufacturers.

The F.B.I. directs the attention of manufacturers throughout the country to their position as affected by recent legislation on the question of Smoke Abatement—a question which was raised before the Executive Committee of the F.B.I. on December 12, by a report from the Federation's Production Committee.

Under the Smoke Abatement Act of 1926, local authorities are empowered to frame bye-laws for the purpose of smoke abatement. A standard bye-law for black smoke was drafted by the Minister of Health providing that the emission of two minutes' black smoke in the aggregate during any half-hourly period should be regarded as a nuisance under the Act. The Federation protested against this draft bye-law, and, as many local authorities had made application for confirmation of bye-laws, the Minister of Health ordered a local enquiry to be held last July in Bradford to consider the application of the Bradford Corporation.

The findings of this enquiry have now been issued. For the West Riding area a three minutes' period has been admitted instead of the two minutes provided by the standard draft bye-law, and this period will therefore no doubt be adopted by the Bradford and other adjacent manufacturing areas which were parties to the application.

The Federation appeared at the enquiry and contested that before any period was determined is was essential that the quantitative definition of what constitutes black smoke as a nuisance should be laid down. The Minister has declined to adopt this view, and the Federation have lodged a strong protest against his attitude.

THE AURORA RED LINE.

By Joseph Kaplan.
(University of California at Los Angeles.)

(*Proceedings N. Academy of Sciences.*)

Recently the author reported some experiments concerning the excitation of the aurora green line when oxygen was mixed with active nitrogen. In that report it was mentioned that a red line having a wave-length of 6654.8 A.U. was also excited and its agreement with an unclassified oxygen line prompted the suggestion that the line 6654.8 may be an oxygen line. One would therefore be justified in concluding that this line should be observed in the light of the night sky and in the Aurora Borealis.

Following a suggestion by Dr. G. Cario, the author re-examined the plates on which the red line was photographed and the conclusion has been reached that this " line " is in reality a band belonging to the first positive group of nitrogen. In the following discussion the reasons for this conclusion will be presented.

While studying the conditions under which the green line was excited it was noted that the red line diminished in intensity very little, as the amount of oxygen was reduced. Because of this it was doubtful whether or not this line should be assigned to oxygen. It was difficult, however, to call it an α-band since each of the other bands in the afterglow consisted of four heads, whereas this would have been an α-band with a single head. A photograph of the discharge tube spectrum in this region showed only the usual four-headed bands, and did not show this line at all. Consequently, it seemed reasonable at the time to assign the line to oxygen, especially in view of the remarkable agreement in wave-length between it and the unclassified line of oxygen at 6654.8 A.U.

Using the data presented by A. H. Poetker it is possible to predict the positions of α-bands corresponding to transitions that are normally very weak in the discharge tube. In active nitrogen, many of the excited molecules of nitrogen find themselves in the B^{10}, B^{11} and B^{12} states. The strong afterglow hrands correspond to B-A transitions in which the vibrational quantum numbers change by -3, -4, -5 and -6. Because of the prevalence of these excited states the transitions B^{12}-A^{10} and B^{11}-A^{9} might well be expected to appear in the afterglow. Therefore, the first heads of these bands were calculated and predicted to fall at 6670 A and 6764 A, respectively. From these predicted positions of the first heads, still using data presented by Poetker, it was possible to predict the second head of these bands and these were found to be at 6754 A and 6657 A. On re-examining the plates it was found that there was a single head at about 6750 A superposed on a background of other normal first positive bands. This value, taken in conjunction with the position of the red " line," justifies the conclusion that these two single heads must correspond to the second heads of the bands arising from the B^{12}-A^{10} and the B^{11}-A^{9} transitions. The meaning of the curtailed development of these bands as contrasted with the normal development of the other bands is not understood at present and this will be studied at the first opportunity. Because of the assignment of the " line " at 6654.8 to the α-group one can conclude definitely that the green line is the only line of oxygen that is excited by active nitrogen in the visible. This agrees with the bulk of experimental evidence according to which the green line is the only oxygen line that has been found in the Aurora Borealis and in the light of the night sky.

Recently McLennan, McLeod and Ruedy concluded from the newly determined Zeeman effect of the green line, that it arises in a transition between the two low-lying metastable states $^1S_0$-$^1D_2$. Assuming this as the proper classification of the green line, one can give a lower limit to the wave-length of transitions between these two metastable states and the normal triplet levels $^3P_{0,1,2}$. This is done by simply remembering Hopfield's discovery that the energy difference between the two far ultra-violet singlet lines of oxygen at about 1217 and 999 U.A., respectively, is exactly the energy corresponding to the green line. This means that the two lines correspond to transitions between a common upper level and the two metastable states, $^1S_0$ and $^1D_2$. This common upper level must therefore lie 12.34 volts above the $^1D_2$ level. Since the ionisation potential of oxygen is 13.56 volts the transition $^1D_2$-$^3P_{0,1,2}$ can be no greater than $13.56-12.34=1.22$ volts. Consequently, lines corresponding to those transitions must lie above 1μ. These are the only transitions that can result in a red auroral line and one is therefore not surprised at the non-observance of a red auroral line in the aurora or in the night sky.

Similarly, the transitions $^1S_0$-$^3P_{0,1,2}$ must lie at wave-lengths higher than 8575 A.U.

and no such transitions have been observed in the Aurora, in the night sky or in laboratory experiments. This is not surprising because of the great improbability of intercombinations. It therefore seems probable that the green line is the only oxygen line in the auroral spectrum.

THE FORESTS OF SWEDEN.

Recently Professor of Forestry, University of Edinburgh (R. P. Stebbing, M.A., F.H.S.), read a paper before the Royal Society of Arts on "Forestry in Sweden," in the course of which he said that the total land area of Sweden amounts to 102 million acres, of which 57 per cent. consists of forest land, exclusive of marshes, bog land, etc., covered with a more or less scattered tree growth (some of it analagous to the *tundra* of North Russia). The proportion of forest varies in the different parts of the country, to some extent being dependent upon climatic conditions. The country being elongated from north to south the climatic conditions are of a ruder type in the north, and growth, especially tree growth, correspondingly slower. The soils over this large area of forest country are scarcely suited for anything but forestry, consisting chiefly of stony moraine soil and, in certain localities, of fertile calcareous moraines and clays. As at present ascertained, the total forest area amounts to about 58 million acres.

From the forestry point of view Sweden may be divided into three parts, Norrland (north), Svealand (central) and Gotäland (south). The State and other public forests are mainly situated in the north—31 per cent. as compared with 13 per cent. and 8 per cent. respectively in the central and southern parts; the largest forest owners are the private limited timber companies who own 35 per cent. of the forests in the north, 31 per cent. in the centre and 9 per cent. in the south; next come the large landlords with 1 per cent., 9 pe rcent., and 11 per cent. respectively; lastly, the small landlords, including a large number of farmers owing small forests, with 33 per cent., 47 per cent. (in north and central), and the large area of 72 per cent. of the forest tracts of the south. From this division in the ownership of the forests it follows as a natural outcome that the forestry work in Norrland and the greater part of Svealand is in the hands of, and is carried out by, the large exploiters, the State and the big timber companies who provide the bulk of the timber, wood pulp, etc., for export. In the south, forest operations are on a smaller scale, and are connected in the first instance with providing for the requirements of the much denser agricultural population to be found in this region. This does not mean that there is not a considerable area of forest in the south, the figures for area proportions from north to south being roughly 13, 5.7 ,and 4.9. A large proportion of the latter area consists of young stands, and a knowledge of the large exports which Sweden has sent to this country and elsewhere during the last sixty years provides the reason. For the southern forests had to bear the brunt of the lumbering of the early days, and at that period commercial forestry or lumbering governed the policy of Sweden in order to provide the materials with which to supply her own mportant iron industry and to capture the European softwood markets.

The forest flora of Scandinavia is well known, but it will be necessary to briefly draw attention to certain characteristics. The great Scandinavian timber belt, which stretches from Norway through Sweden, Finland and North Russia, into Northern Siberia, consists primarily of conifers, the softwoods comprised by the Scots Pine and European Spruce mixed with Birch and a few other hardwoods. In Sweden the dominating type is pine (*Pinus sylvestris*) and spruce (*Picea excelsa*), occurring either pure or in mixture. The hardwoods in comparison with this dominant type play a much smaller part. At the upper limit of the forest line in the northern mountains the birch (*Betula alba*) occurs, which has merely a protective value. Below and covering a large area of country stretching into Central Sweden the two conifers occur mixed with birch, aspen and alder in smaller and varying amounts, the first-named tree being the commoner.

The sawmill industry still remains the largest consumer of timber in various forms. The most characteristic feature in economic development of recent years however, is the gigantic expansion of the wood-pulp industry, a factor not without its importance to the press of this country. Sweden occupies at the present day the premier position amongst the sulphite-producing countries in Europe; and its exports of wood-pulp are probably larger than those from any other country. The importance to Sweden of this position is readily perceivable. The woodpulp industry is the foundation of her papermaking industries, and further, it affords a

valuable economic support both to the saw-mill operations in utilising waste, and, even more important, permits of adequate and repeated thinnings being made in the young woods, since the material therefrom is saleable.

Some curious facts have come to light on the subject of the variations in the proportions of the population of Sweden employed in the different industries. A considerable decrease in the numbers employed in agriculture took place between 1870 and 1920, in spite of the area cultivated increasing by 50 per cent. The decrease is attributed to the increased use of machinery in agriculture.. The following figures for the populations employed in agriculture, industries and commerce and in the Public Services and professions between 1751 and 1920 are not only of interest, but have some significance for Great Britain. The figures are given for percentage of population :— 1. *Agriculture with kindred industries* (forestry, etc.) year 1751, 80 per cent.; 1840, 81 per cent.; 1870, 72 per cent.; 1900, 54 per cent; 1920, 44 per cent. 2. *Industries and Commerce*, year 1751, 10 per cent.; 1840, 11 per cent.; 1870 20 per cent.; 1900, 39 per cent.; 1920, 51 per cent. 3. *Public services and professions and other trades*, year 1751, 10 per cent. 1840, 8 per cent.; 1870, 8 per cent.; 1900, 7 per cent.; 1920, 5 per cent.

Felling in the forest and extraction work to the conversion or exporting centres presents few difficulties in a country such as Sweden, where water facilities in the north and centre are abundant. Labour, mostly domiciled on farms in the vicinity of the forest, is abundant, and the farmers and their employees are conversant with forest work. The farmers bring their own horses with them when working in the forest. In the case of the State and large forests owned by Companies, a permanent staff is maintained throughout the year (supplemented when required), who occupy small tenant farms (small holdings), situated throughout the forests. Felling and transportation in the forests is paid by piece-work. In the northern and central parts of the country snow facilitates the transport of the timber to the waterways, and floating is the chief method of transport. In the south snow is less abundant, and waterways are scarcer. Forest produce is, therefore, taken by road to the railways and at times by canal. The length of the waterways used for floating purposes amounted to 19,000 miles in 1927, about 450,000,000 solid cubic feet of timber being extracted by this means. The annual cost of floating this material amounted to 26,000,000 Kr. (appproximately £1,450,0003, or about one-seventh of the cost by railway for the same distanct at existing rates. The distance from the forest to the waterways varies from 1-4 miles only.

The chief factor governing Sweden's large export trade in forest produce is to be found in the fact that there are about ten acres of forest and eight cubic metres of annual growth per head of population. It is for this reason that so weighty a proportion of Swedish industries are based on the forests and their product. The value of the exports of pulp, paper, etc., rose from £19,400,000 to £22,800,000 between 1924 and 1926, whilst wood goods of all kinds decreased from £15,900,000 to £14,300,000 during the same period.

In the case of Europe, Sweden at present holds the premier place as an exporter of soft woods, both in amount and in the high grade of its products as placed on the markets. Of these exports Great Britain took 41 per cent. in 1927 as against 32 per cent. in 1913.

PROFESSOR EINSTEIN AMPLIFIES HIS THEORY OF RELATIVITY.

Prof. Einstein (Prussian Academy of Science) has written an important paper entitled " A Uniform Theory of Fields of Force," which amplifies his previous statements on the Theory of Relativity. It is expected that the Academy will publish the new paper at an early date.

BOARD OF TRADE ANNOUNCEMENT.

Area Gas Supply Committee.

The Board of Trade have appointed the following committee :—

Sir Alexander Walker K.B.E. (chairman), Mr. Thomas Hardie, M.Inst.C.E., Mr. C. H. Lander, C.B.E., D.Sc., M.Inst.C.E, Mr. W. A. Lee, C.B.E., Mr. M. Mannaberg, Sir R. A. Pease, Bart., J.P., Mr. S. Tagg, M.Inst.C.E., J.P.,

to undertake an investigation as recommended by the National Fuel and Power Committee in its report of September, 1928, in relation to a limited area, such as that between the Humber and Liverpool and between Leeds and Birmingham, respecting the technical and economic aspects of an area gas supply system, comprising an interconnecting network of pipe lines fed by a number of gas works, coke ovens and the like.

GENERAL NOTES.

CHEMISTRY AND THE CLASSICS.

Dr. Herbert Levinstein, president of the Society of Dyers and Colourists, presided at the Ramsay Chemical Dinner held on December 11, at the Grosvenor Restaurant, Glasgow. Among the speakers were Principal Sir James Irvine, of St. Andrew's University, Sir Henry Keith, and Mr. Craigie M. Aitchison.

Replying to the toast of "The Profession of Chemistry," Dr. Levinstein said he rejoiced to see the increasing contact between the academic and the industrial world of chemistry. The formation of giant combines such as we had in England in the I.C.I. was a matter of the greatest importance to young men entering their profession. No combines, cartels, or trusts in chemistry could prevent, should they want to, an exceptional man from developing individually, but he must be original.

He would like to see a knowledge of physics and chemistry and other natural sciences considered to be as much a sign of culture as a knowledge of the classics. Properly taught there was as much culture to be derived from science as from the humanities, and more useful knowledge. The date when Ramsay discovered helium gas imprisoned in a stone called cleveite, now old, but a young stone when it first caught its helium and kept it, was of greater interest to a cultured mind, and of far greater importance, than the date of the Battle of Lutzen.

If some old bone revealed to the anthropologist the story of our evolution, was it not worth the knowing? If some old stone released helium after aeons we could not measure and this helium turned out to be a brick left over by the Master Builder of the universe and Ramsay found it, was that not enough to immortalise the name of Ramsay? Was that a cultural achievement equal to that of suggesting a brilliant emendation in a Virgilian text? And yet we called the one a cultured scholar, a pursuer of the humanities, the other merely a man of science. An increasing number of our youth should be taught science, particularly chemical science, not to equip them for any profession, but, as they learned classics, to train their minds, to teach them to think, and, in short, to educate them.

BRITISH INDUSTRIES FAIR.

Advance Catalogue Launches Britain's New Year Trade Push.

We have received a copy of a special advance overseas overseas edition of the catalogue of the London Section of the British Industries Fair, 1929, which is now being issued to 10,000 business men in Europe, North America, South Africa and the eastern coast of South America, including all those buyers who have notified the Department of Overseas Trade of their intention to attend the Fair. By this publishing feat, which has only been made possible owing to the keenness of British manufacturers to participate in the Fair, trade buyers in cities as far apart as Constantinople, Capetown and Vancouver will be able to receive a copy of the Fair catalogue, before commencing their voyage to England. The catalogue, apart from containing descriptive entries of the exhibits of more than 1,200 British manufacturers, embodies a complete classification of all those exhibits by trades and indexes in 9 languages, enabling foreign buyers easily to trace the goods in which they are particularly interested.

Enclosed with this 700 page catalogue is an advance list of some 700 firms exhibiting at the Birmingham Section, which takes place concurrently with the London Section from February 18 to March 1.

MODERN SWIMMING BATH OPERATION.

The Latest Scientific Principles.

By A Well-Known Engineer.

The danger to health involved in the continuance of the ordinary and insanitary methods of filling up a swimming bath with fresh water and emptying it out again, swarming with bacteria, are now at last being realised. For example, there are 47 public swimming baths in London with a total attendance of 5,000,000 per annum, and apart from colds sore throats, bad eyes, and paratyphoid, much more serious diseases can be conveyed, especially as the water may become contaminated in a few hours. The modern scientific method is of course sterilisation and general purification in a continuous circuit, so as to give all the time a water that is clear, sparkling, and entirely free from obnoxious bacteria. In this connection there has been started up at the Wolverhampton Municipal Baths a fine

plant which represents the latest principle for a large installation, including continuous filtration, sterilisation by chlorine gas, coagulent treatment, aeration, and automatic temperature control, carried out in a closed circuit.

At Wolverhampton there is a first-class bath having a capacity of 90,000 gallons, and a second-class of 110,000 gallons, and the whole contents of both baths are circulated through the filtration and purification plant every four hours, that is at the rate of 50,000 gallons per hour. The exact series of operations, in the following order, consists of straining, treatment with alumina, ferric and soda ash coagulent to separate all the colouring matter, using two sets of chemical injection pumps along with storage tanks, filtration through five 8 feet diameter sand pressure filters with a total of 250 square feet filtering surface, fitted with compressed air cleaning, aeration to give the sparkling conditions of fresh water, also compressed air, using an electric driven blower, continuous sterilisation with chlorine gas by the "Chloronome" apparatus, requiring generally about one part of the chlorine per two million parts of water, and a Calorifier to maintain the temperature of the water at 72° F. in summer and 78° in winter. Some of the main points of interest are, apart from the "Chloronome," ample area in the sand filters with slow passage of the water, accuracy of admission of the coagulents, and an improved type of aerator with a vent pipe for dissolved gases, while the circulation is maintained by means of an electric driven centrifugal pump with a capacity of 50,000 gallons per hour.

TENDER FOR DRUGS, ETC., FOR EGYPT.

The Commercial Secretary at Cairo (Mr. Richard Turner, O.B.E.) reports that the Egyptian Department of Public Health is calling for tenders, to be presented in Cairo by the 17 February, 1929, for the supply of drugs, etc. (*i.e.*, proprietary articles, drugs and chemicals, galemicals and packed articles) required during the year commencing 1 May, 1929.

Firms desirous of offering goods of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 5002 should be quoted.

WAVE LENGTHS AND ZEEMAN EFFECTS IN YTTRIUM SPECTRA.

By William F. Meggers.

(*U.S. Bureau of Standards.*)

The wave lengths corresponding to approximately 1,000 lines photographed in the arc and spark spectra of yttrium were measured relative to secondary standards in the iron spectrum. The values extend from 2127.99A in the ultra-violet to 9494.81A in the infra-red. Comparison of relative intensities and other characteristics of lines in the different sources permitted a sharp discrimination between four classes of lines; about 500 are ascribed to neutral atoms (constituting the YtI spectrum), 240 originate with singly ionised atoms (YtII spectrum), 10 belong to doubly ionised atoms (YtIII spectrum), and most of the remainder describe the band spectrum characteristic of molecular compounds, presumably yttrium oxide. Measurements of Zeeman effects (photographed by Moore) for 220 yttrium lines ranging in wave length from 3173A to 6896A are included.

FERTILISER INDUSTRY.

Owing to various developments which have taken place in connection with the fertiliser interests of Imperial Chemical Industries Limited (particularly the formation of Scottish Agricultural Industries Limited) and to the inauguration by the Government of the Agricultural Credits Scheme, the project which the Company had in mind for the inauguration and support of a special Imperial Grassland Association has proved unnecessary and incapable of complete realisation without duplication and overlapping of effort. Lord Bledisloe, who had been invited to become the chief of this new organisation (and who, it will be remembered, relinquished his membership of the Government with that object in view) has retired from his association with the project. While regretting this step and acknowledging Lord Bledisloe's willingness and ability to undertake the work which would have been entailed had the scheme been proceeded with, Imperial Chemical Industries Limited realised, in view of the developments which have taken place, that it had no alternative but to release Lord Bledisloe. At the same time, the Company is pleased to announce that it has obtained Lord Bledisloe's consent to a continuance of his assistance in an advisory ad consultative capacity on agricultural questions generally.

EASTERN CANADA'S CHEMICAL INDUSTRIES.

SOME IMPRESSIONS OF THE BRITISH CHEMICAL ENGINEERS' TOUR.

[We are indebted to *Canada*, the well-known illustrated weekly journal, for the letterpress and illustrations of the following interesting article.—ED., C.N.]

Our party numbered nearly 200, and included men of science, men of business, and a number of ladies. The tour was organised by the American Institute of Chemical Engineers and the British Institution of Chemical Engineers, under the presidency of Sir Alexander Gibb, G.B.E., whose work as a builder of bridges is to be seen in many parts of the Empire. In addition to the members of the two organisations of Chemical Engineers, a large number of members of the Society of Chemical Industry, the Anglo-American body which represents industrial chemists on both sides of the Atlantic, joined the tour.

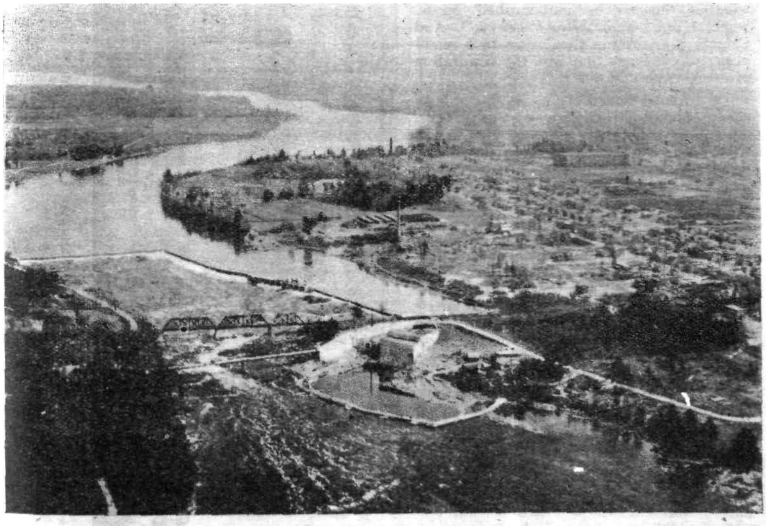
In the result, men of varied interests were included in the visiting party—chemists, gas engineers, works managers, chemical engineers, civil engineers, professors and lecturers, physicists ,coke-oven managers and students —the great majority of whom were seeing the splendours of Canada for the first time.

The party gathered from different points at Quebec—a charming introduction to Canada. The Old World atmosphere made an immense appeal to everybody who knew France, and it was difficult to realise that we were some 3,000 miles from the Quai D'Orsay.

A GREAT CHEMICAL INDUSTRY.

Naturally enough, in view of the composition of the party, the industries most carefully studied were those appertaining to chemistry. But so wide is the range of the industrial chemist of to-day that there is scarcely an industry in which he is not interested.

Already, we found, Canada has a great chemical industry, although its present dimensions will seem insignificant with the expansion of the next twenty years. Some 1,300 plants are already functioning, with products having a selling value of more than



The Southern Canada Power Company's Drummondville development, on the St. Francois River, Quebec.

$726,000,000 a year, and even these impressive figures leave out the selling value of the output of quite a number of plants engaged in electrometallurgical operations of different kinds.

Everywhere the party went, one fact stood out above all others. The virility of Canadian industry is unmistakable. The men in charge of organisations, and the men who work under them, are all imbued with a fine keenness, a sense of working at a worthwhile job. There is obviously no room for the "half-timer"—the man who works half his time and slacks for the other 50 per cent. This fact was as obvious in the plants in Quebec Province as in the mines of Ontario, and the type of executive was extraordinarily good wherever we ment.

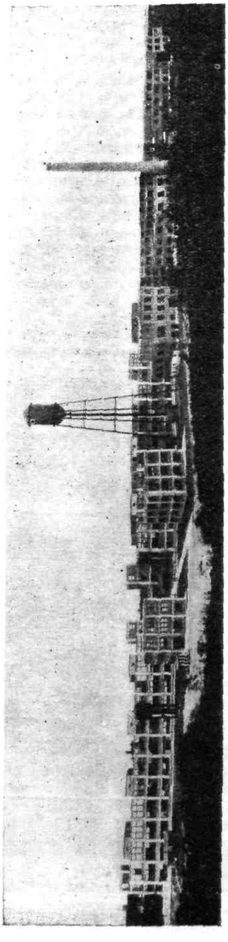
CHEAP POWER.

The immensity of her water-power inevitably predicates a great industrial future for Canada in these days of hydro-electrical plants, and in no industry is this more obvious than in the chemical. "Cheap power and still cheaper power" is the cry of the manufacturer of chemical products, whether finished or part-finished goods, whether fine chemicals or "heavy." And Canada is answering that cry with a readiness and efficiency that won the admiration of every expert in our party.

Take Shawinigan Falls as an example of cheap power begetting new industries. Twenty-five to thirty years ago it was a wilderness, the haunt of the hunter and fisherman, with hardly a house in the neighbourhood, and to-day we see a thriving town with a population of over 15,000—and a town, moreover, which is laid out for expansion with wide streets and a sound system of town planning in operation.

It is hard to find words to express the admiration we felt for the enterprise, the driving force which ha dcarved the immense hydro-electric power station out of the wilderness and had harnessed the waters of the St. Maurice to provide more than 580,000 h.p. for industries and homes.

It is no wonder that calcium carbide from Shawinigan Falls is exported all over the world, and we learned with interest from one of our own party, who had played an important part in the preparation of chemicals required for the prosecution of the war, of an interesting fact regarding this Quebec carbide. But for the supply of calcium carbide from the mines at the Falls he said, there would have been such a shortage of acetone "dope" for the wing-fabric of allied aircraft as would have interfered seriously with the work of this all-important unit of the Allied forces.



The Canadian Celanese Plant at Drummondwille, Quebec.

And then there are the huge paper mills, so typical of the full use being made of Canada's immense resources in wood suitable for all classes of paper, from newsprint to a high-grade writing paper that would grace the bureau of an Empress.

Other industries will come to this town of the Falls—that is obvious in view of its ever-growing capacity to produce electric current at a favourable price.

The figures of its increase in horse-power read like a fairy tale. During the last 28 years the sales of Shawinigan electricity have doubled during every five-year period. That is to say, for every horse-power of electricity produced in 1900 as much as 32 is sold to-day, making the company the fourth largest electrical company in the world.

ARTIFICIAL SILK.

And what a trim town Cornwall is, with its great pulp and paper mills and the new Canadian Cellulose Company, one of the greatest chain of plants that is springing up in all parts of the world to aid in the manufacture of the material that woman has adopted so wholeheartedly—artificial silk. What prospects of hydro-electric development are held out by the Long Sault Rapids in the St. Lawrence River! One can visualise a huge power station there, supplying a growing group of manufacturers with the life blood of modern industry—cheap power.

Then, too, there are the celanese works at Drummondville also engaged in the production of artificial silk—another town with a future.

Then followed the tour up to Kirkland Lake, where precious metals are won from the bowels of the earth of Northern Ontario. Look at the high grade, efficiently run plants at Lake Shore, at the Wright-Hargreaves mines, at the Teck-Hughes and the Sylvanite. Nothing is wasted that is mined, and the cyanide mills are amongst the most efficient in the world. Admittedly the town is young; but there is a solidity and a sturdiness about its growth that augurs well for the future.

Nickel refining is one of the industries which make Port Colbourne, at the Lake Erie end of the Welland Canal, and the International Nickel Company of Canada, Ltd., has already achieved distinction in its own field.

This tour of ours took in Niagara, the never-to-be-missed. Here indeed is Canadian industry to be seen at its best, making the members of our party realise forcibly what really cheap power means, and wish that this low-priced current were available at home. And what a wonderful range of industries has grown up on the nourishment which this cheap power supplies. Electro-chemical, electro-metallurgical, pulp, paper and ceramic industries—all basing their progress on cheap hydro-electric power, but using only an insignificant part of the huge output of 1,000,000 h.p., a figure which is in vivid contrast with the initial load of 1,000 h.p. with which Niagara power began.

THE BALANCE OF TRADE.

Yet the balance of trade is still against Canada in the chemical industry, in spite of the steady expansion already noticed. The Dominion imported chemicals and allied products to the value of $33,312,000 in 1927, and exported $17,854,915—figures which her industriousness and driving force will not allow to stand for many years longer. Where do the bulk of Canada's exports in this industry go? The United States took nearly $9,000,000 worth of goods and the United Kingdom only some $4,000,000—figures which we hope to see reversed proportionately in the years to come.

AN IMPORTANT BRITISH DEVELOPMENT IN THERMAL STORAGE.

A problem in steam raising, almost as important as efficient combustion itself, is that of maintaining a regular load on the boilers despite the fluctuating demands that may occur from time to time throughout the operating day. There are very few steam-raising installations where the steam demand is constant and hence, while an installation may be operated at very high efficiency on full load, there are periods when the lightness of the load calls for small steam output and involves low efficiency. Nevertheless the capacity of the plant must be equal to that of the peak of the load.

In cases like this (and they are very numerous) it is apparent that any me thod has a high value which will enable the plant to operate for normal output during periods o flow load and conserve the heat for use during periods of peak load. Such a process not only secures much more efficient working through the whole period, but allows much higher peak demands to be met without increasing the capacity of the plant. Fortunately the steam accumulator,

which has come so prominently to the front of late, affords this facility. During the last few years attention has been consistently directed to methods of steam-heat accumulation, in which the surplus steam generated during periods of normal operation on light load is condensed to water in order to conserve the heat. In this system, when the demand for steam is greater than the normal steaming rate of the plant, the pressure is allowed to fall and the water evaporates and is used as steam at lower pressure to augment the steam from the boilers. Since, however, the water in which the heat is thus accumulated cannot be evaporated except by reducing the pressure imposed upon it, the system is only readily adapted to works requiring two or more pressures. It will be appreciated that in this method the accumulator shells must necessarily be large, as they must hold sufficient water to condense all the surplus incoming steam.

Distinct from this system of falling or variable-pressure accumulation is the constant-pressure system. The latter system possesses distinct advantages in many industries where single pressures, as well as more than one pressure, are used. Under this heading comes Dr. Kiesselbach's system, the rights of which are being taken over by a company now being registered which will operate the system and manufacture the plant in this country. The system consists primarily of a storage tank in which water is accumulated and maintained at both boiler temperature and pressure. The accumulator is in direct contact with water in the boiler, by means of an overflow pipe from the boiler which mantains constant water level, and the water is circulated from the boiler to the accumulator and from this storage-vessel back to the boiler by means of a circulating pump. The normal feed-water is controlled by a pressure-operated regulator connecting the feed pump and the live steam delivery line, and the feed pump then operates in accordance with the rise in boiler pressure. A pressure equilibrium pipe admits steam from the boiler on to the top of the water in the accumulator and ensures that the accumulated water is maintained at boiler pressure and temperature. The system is particularly simple, being briefly as follows :—

Under conditions of normal operation of the boiler the circulating pump runs normally, the feed pump passing the same quantity of water as is being evaporated. In the event of a decreased demand on the steam line the pressure tends to rise and the automatic regulator between the live steam line and the feed pump supplying the boiler opens, admitting more steam to the feed pump and increasing its speed and the quantity delivered. The consequent rise of water level in the boiler causes an overflow of water to the accumulator and the low-temperature water admitted to the boiler tends to lower the pressure. As the demand for steam increases the pressure tends to fall, with the result that the boiler feed pump is slowed down while evaporation in the boiler continues. At the same time, water which is at full boiler temperature and pressure is circulated from the accumulator, flowing to the boiler and back to the accumulator. In this way the water level in the accumulator continues to fall at the exact rate at which it is being evaporated, but during this period of excessive evaporation, the boiler is fed with water at boiler temperature and pressure and consequently only the latent heat to convert this water to steam at the same temperature has to be added. When the period of excessive steam demand is passed evaporation again becomes normal, the pressure regulator admitting water from the feed pump, restoring the water level in both the boiler and accumulator.

It will be seen that this system has all the advantages of constant rate of firing irrespective of the demand for steam, and the maintenance of constant combustion conditions at the highest efficiency, regardless of steam output. Moreover, constant boiler pressures are easily maintained under the heaviest possible fluctuations of load. Not only may the full output be maintained on a reduced number of boilers, but the mechanical circulation causing a velocity of flow in the water tubes of the boilers sweeps all sediment and steam bubbles off the heating surface, with distinctly increased efficiency of heat transference.

The system has been in operation for some time at a large number of German steam-raising plants, including electricity works, collieries, manufacturing plants, dye works, breweries, etc. As an example of the actual saving of coal due to the installation of Kiesselbach thermal storage plant, may be taken the case of a colliery at Essen. The cost per ton of steam was reduced from 3.1s. to 2.15s. by this installation. Even accepting this as exceptional, a fuel economy of 10 to 18 per cent. is

invariably reported. The chief engineer at the State Electricity Works, Hertfort, reports that the scale in the boiler tubes is materially reduced by the use of the system, and he considers that the installation has really increased the steaming plant capacity by the equivalent of two more boilers. The actual installation comprises five inclined tube boilers to which two new shells have been installed to act as accumulators.

The new company which is about to be registered, with a capital of £220,000, for acquiring and operating the British and American patents and rights, is Kiesselbach Steam Accumulators, Ltd. A distinguished and experienced board has been appointed and International Combustion, Ltd., are closely associated with the company exploiting the system.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY OF LONDON.

December 19, 1928, Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the chair.

Dr. C. A. Matley gave a short account, illustrated by lantern-slides, of a visit to the crater of Papandajan (Java) on January 7, 1925, at which date, and for some twelve months previously, it was under observation by Dr. N. J. M. Taverne, of the Dutch East Indies Mining Service. The crater was closed to the public owing to a recent fatality, and Dr. Matley expressed his indebtedness to the Director for special permission to visit it, and also to Dr. Taverne for acting as guide and for explaining his methods of vulcanological research.

The crater and its walls had been mapped on the scale of 1 : 2,000, with contours, and all the vents and fissures recorded. The temperatures of the fumaroles, solfataras, hot springs, and mud-holes were taken daily. A seismometer and a Milne seismograph had been installed, and another of improved type was about to be erected. A torsion-balance had been ordered, with the object of ascertaining changes of mass in the volcano, and detecting movements of the magma. The problem of determining the stages leading to an eruption and, if possible, of predicting it, was therefore being attacked from three sides : namely, temperature, crustal movement, and movement of magma. In addition, the nature and quantity of the gaseous emanations, and the changes in them, were also being studied. The general conclusion drawn at the time of the visit was that the mass of lava was rising, but had not yet come directly into action, as the volcanic ash thrown out at recent eruptions consists of previously consolidated and propylitized material, and no new lava is present in it. The study of this volcano is of importance, as no fewer than 3,000 lives were lost in the eruption of 1772.

Descriptions were given of the phenomena seen, including the destruction of part of a forest by a recent eruption of propylitized ash. A full account of the observations by Dr. Taverne will be found in 'Vulkanologische Berichte' vol. xxxiii (1924) and vol. xlii (1925), as also in 'Vulkaanstudien op Java,' 1926.

The following communication was read :

The Geology of the District between Llanymawddwy and Llanuwchllyn (Merioneth). By PROF. WILLIAM JOHN PUGH, O.B.E., B.A., D.Sc., F.G.S.

The paper deals with an area of nearly 40 square miles in South-Eastern Merioneth, and the rocks belong to the Bala and the Valentian Series.

There are important lateral changes within the Bala Series, and these reveal the transition from the succession described at Corris and Dinas Mawddwy to that around Bala. The Bala rocks become more arenaceous and more calcareous from south to north, and this general change in lithology is accompanied by a gradual increase in the number and variety of shelly fossils.

The basal Ceiswyn Beds, which overlie the Llandilo volcanic rocks, consist of dark graptolitic slates. In the southern part of the district, these slates are followed by a great thickness of practically unfossiliferout mudstones; but the uppermost Ceiswyn Beds are calcareous, ashy, and yield shelly fossils in fair abundance. These Upper Ceiswyn Beds pass laterally into the Gelli-Grin Calcareous Ash Series with the *Nicolella-actioniæ* fauna, while the beds beneath pass northwards into the Nant-hir Shales, the Glyn-Gower Sandstones, and the Allt-Ddu Mudstones, the last-named containing the *Heterorthis-alternata* fauna. The Nod Glas, consisting of black shales and mudstones with thin dark limestonebands, dies out northwards.

The Aberewmeiddaw Group passes laterally into the Rhiwlas Mudstones, but the *Phillipsinella-parabola* fauna disappears as the latter beds are traced southwards from Bala. The Red Vein, or the *Dicellograptus-anceps* Zone, passes northwards into the un-

fossiliferous Moelfryn Sandstones. The succeeding *Phacopsmucronatus* Mudstones correspond with the Narrow Vein and the lower part of the Garnedd-wen Beds at Dinas Mawddy. The Upper Garnedd-wen Beds consist of unfossiliferous shales in the south; but northwards they pass into sandy mudstones with the Hirnant Limestone and the *Rafinesquina-hirnantensis* fauna.

The Birkhill rocks (Cwmere and Derwen Groups) are thinner than in other areas in Central Wales, but the various zones can be compared closely. The succession in the Derwen Group is very similar to that in the Middle and Upper Skelgill Beds of the Lake District, and the rocks can be correlated almost band by band.

The district is situated on the eastern flank of the Harlech Dome, and the rocks strike from south-south-west to north-north-east. They dip east-south-eastwards, but there is some minor folding. There are important strike-faults, which conceal parts of the succession in certain localities. The rocks are highly cleaved. The strike of the cleavage-planes is approximately parallel to the strike of the strata, but the direction of cleavage-dip is variable.

NOTICES OF BOOKS.

Die Spezielle Relativitätstheorie Einsteins und die Logik. Von Dr. J. H. Tummers, zweite verbesserte, vermehrte und umgearbeitete Auflage. Otto Hillmann. Leipzig. 1929. Pp. 32. 1s. 6d.

The building of this booklet is easily to be seen from the successive titles of its chapters: I. Was verstehen wir unter Wissenschaft? II. Der absolute Geichzeitig keitsbegriff ist ein in sich möglicher, widerspruchsfreier Begriff. III. Die zwei Hauptprinzipien der speziellen Relativitätstheorie sind Postulate. IV. Die relative zeit ist das Fundament der speziellen Relativitätstheorie. V. Der Begriff der relativen zeit darf nicht aus den zwei Hauptprinzipien abgeleitet werden. VI. Welchen Weg soll Einstein gehen um zur relativen zeit zu gelangen. VII. Diskussion der Beweise für die relative zeit. VIII. Schlussfolgerungen. IX. Versuche, die logischen Fehler zu eliminieren.

Firstly Tummers tells us what postulates mean to be. Thereon he proves, from Einstein's publications themselves, the Principle of Relativity and the Principle of the Constant Velocity of Light to be indeed postulates. Both principles however are contradictory to each other or their harmonious co-existence must at least be called dubious. This has been completely acknowledged by Einstein himself.

Now we come to the crux of the question.

Says Einstein: these two head principles are contradictory, or appear being so, because the relativity of time has not been seen clearly enough, so: both principles agree because the time is relative.

I beg your pardon, Tummers says, this can neither be called logical nor scientific. You credit time with a special relativity because the principles are indeed contradictory. Here Tummers is obviously right. The vicious circle which is lying at the bottom of the theory of Sp. Rel, is clearly brought to sight: time is relative because the two principles do agree and the two principles agree because time is relative. But indeed the two principles are contradictory consequently the special relative time must be also.

Several attempts have been made to escape from this entanglement. In his own endeavours to eliminate the mistake Tummers re-finds the Fitzgerald-Lorentz contraction and the local time of Lorentz.

Let me put down a marginal note here. "Man gelangt dann aber zu einer Theorie, die äquivalent, ja identisch ist mit der Ehklärung von Lorentz mit Hilfe seiner kontraktionshypothese." (Tummers) . . . This hypothesis however, which in its time of being has been contested almost as much as the special relativity itself, has been completely conceived on the presumption of light being one of the two: emission *or* undulation. But this putting of the problem, which is *not* asked for by logic, has been obviously confuted by the experimental results of the latest investigations, almost all phenomena of radiation bearing nowadays the twofold character of emission *and* ether disturbance. Summarising this we see: a faulty putting of the problem of a most fundamental material problem, which is to be found already with the old Greek philosophers and in consequence therewith the contraction of Fitzgerald Lorentz, the special relativity of Einstein, and yet more contradictions in modern physics . . .

This second edition of this work on special relativity and logic by Tummers who is "privaat docent" in the philosophy of Mathematics and Physics, has undoubtedly by his teaching gained much in perspicacity of the material and simplicity and clearness of description. It is almost perfect.

W. Tombrock.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

ARRANGEMENTS FOR MEETINGS DURING JANUARY, 1929.

Monday, January 21, at 8 p.m.—(Cantor Lecture.) C. H. Lander, C.B.E., D.Sc., M.Inst.C.E., F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research : "The Treatment of Coal." Lecture I.—The Use of Coal in its *Raw State : Historical introduction; Production and distribution*; Sampling and analysis; Efficiency of utilisation; Steam raising; Pulverised fuel; Furnaces and process work; Domestic heat production.

Wednesday, January 23, at 8 p.m.—(Ordinary Meeting). Sir Henry A. Miers, F.R.S. : "Museums and Education." The Right Hon. the Earl of Crawford and Balcarres, K.T., P.C., LL.D., F.R.S., P.S.A., will preside.

Monday, January 28, at 8 p.m.—(Cantor Lecture). C. H. Lander, C.B.E., D.Sc., M.Inst.C.E., F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research : "The Treatment of Coal." Lecture II.—High Temperature Carbonisation Processes and Coke Treatment : Gas manufacture; Purification, blending and sizing; Steaming; Oil injection; Total gasification.

Wednesday, January 30, at 8 p.m.—(Ordinary Meeting.) George Fletcher : "The Shannon Scheme and Its Economic Consequences."

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

Saturday, January 19, at 3 p.m. — "Flemish and Belgian Art—The Portrait." By E. Cammaerts.

Tuesday, January 22, at 5.15 p.m.—Dr. F. A. Freeth : "Critical Phenomena in *Saturated Solutions.*"

Thursday, January 24, at 5.15 p.m.—Mr. Gordon Home : "Roman London."

Friday, January 25, at 9 p.m.—Prof. A. C. Seward : "The Vegetation of Greenland."

Saturday, January 26, at 3 p.m.—Mr. E. Cammaerts : "Flemish and Belgian Art—The Landscape."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

38,422.—Bigourdan, P. E.—Manufacture of copper sulphate. December 29th.

38,086.—Lonza Elektrizitatswerke und Chemische Fabriken Akt.-Ges.—Production of ammonium formate. December 24th.

38,259.—Meuris, H.—Manufacture of sulphuric acid. December 28th.

Specifications Published.

302,620.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.).—Joint manufacture and production of valuable liquid and other hydrocarbons and derivatives thereof and ammonia.

302,834.—Dean, H. P., and Imperial Chemical Industries, Ltd.—Valves.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

300,184. Alumina sodium aluminate, sodium sulphide.—Mond, A. L., 19, Southampton Buildings, London.

Clay, phonolite, leucite, etc., are treated with sulphuric acid or a mixture of sulphuric and hydrochloric acids. After separating insoluble matter, the solution is evaporated with an amount of sodium chloride equivalent to the sulphuric acid, and the residue is heated to 700° C., preferably in a rotary furnace in which the materials and the heating-gases pass in the same direction. Hydrochloric acid is evolved. The sintered product is heated to 1,000° C. with carbon to produce sodium sulphite, sodium aluminate and some soda. The product is lixiviated. *Some of sodium sulphite may be separated* by crystallisation, and alumina is precipitated by treatment with sulphuretted hydrogen or carbon dioxide or a mixture of these gases. Further quantities of sodium sulphide may be separated by crystallisation. The mother liquor, or the liquor before separation of sodium sulphite may be treated with carbon dioxide to separate

sodium bicarbonate. If the clay, etc., has been treated mainly with hydrochloric acid, alkali sulphate may be added to the sintered product, and if only small amounts of hydrochloric acid have been used, bauxite may be added in order that the sintered mass may contain about equimolecular proportions of alumina and alkali sulphate.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BRONCHELIX.

496,767.—Chemical substances prepared for use in medicine and pharmacy.—George Richard Williamson, trading as Lester and Williamson, Great Heath Pharmacy, 428, Foleshill Road, Coventry. January 2nd.

EUMOCOL BRAND.

497,276.—Chemical substances prepared for use in medicine and pharmacy.—H. R. Napp, Limited, 3 & 4, Clements Inn, Kingsway, London, W.C.2. January 2nd.

"KROPON."

497,586.—Chemical substances in class 1, in the form of adhesives for use in manufactures.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse, 28, Frankfort-on-Main, Germany. January 2nd.

DRAGONFLY.

496,301.—Mineral aniline dyes in powder form.—David Anderson and John Lorimer Mill, trading in co-partnership, 11, Miller Street, Glasgow, C.1. January 2nd.

DYESTUFFS INDUSTRY DEVELOPMENT COMMITTEE.

The Board of Trade have appointed Mr. J. Rogers, O.B.E., F.I.C. of the British Dyestuffs Corporation, Ltd., to be a member of the Dyestuffs Industry Development Committee under the Dyestuffs (Import Regulation) Act, 1920, in place of Dr. E. F. Armstrong, D.Sc., F.R.S., J.P., resigned.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : MERTON HOUSE, SALISBURY SQ.. LONDON, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3589.

MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

TELEPHONES :

Administrative : Central 6521.
Printing Works : Hop 2404.

CONTENTS. PAGE.

Detection of the Presence of Reducing Radicals in the Systematic Analysis for the Acids 50
By L. J. Curtman and W. W. Plechner.

Catalytic Oxidation of Naphthalene ... 51
By Tokishige Kusama.

The Maintenance of Chemical Plant and Machinery 52
By C. W. Brett.

Registration of Chemists 53

General Notes 56

Proceedings & Notices of Societies :—

The Royal Society 57

The Chemical Society 59

Society of Glass Technology 60

The Optical Society 60

Institution of Mining and Metallurgy 60

Notices of Books 61

Forthcoming Events 62

New Patents 63

New Trade Marks 64

The Rideal-Walker Index shows that each Lysolat is 3 to 4 times more powerful than the same weight of any Lysol in existence and is equal to six times its own weight of the finest carbolic acid.

Since Lysolats received official approval more and more doctors are making them their standard antiseptic and disinfectant.

The solid form renders them particularly convenient to carry in the satchel for use in all circumstances where an utterly reliable and trouble-free antiseptic is desirable. Made in the form of standard sized tablets, Lysolats can be recommended with safety to all classes of patients.

Medical men appreciate the value of a solution of Lysolats in alcohol, which is the quickest and most efficient of all known methods of sterilising instruments.

Members of the Medical Profession are invited to write for free samples of Lysolats to Solidol Chemical Ltd., Ashmead House, Disney St., London, S.E.1.

Lysolats

PATENT 118667 **(LYSOL TABLETS)**

Lysolats are packed in handy tins containing 40 and 80 tablets at 1/3 and 2/- (respectively) and also in tins of 1,000 tablets.

DETECTION OF THE PRESENCE OF REDUCING RADICALS IN THE SYSTEMATIC ANALYSIS FOR THE ACIDS.

By L. J. Curtman and W. W. Plechner.

(The College of the City of New York.)

In the systematic scheme of analysis for the acids it is desirable to make a series of preliminary tests to detect the presence or absence of various groups of acid radicals. Such a procedure materially reduces the time necessary for the complete analysis. Of the twenty-two acids which are commonly considered twelve possess reducing properties. The presence of the latter may be detected by adding a dilute solution of potassium permanganate to the acidified solution of the unknown* and noting whether or not the former is bleached. Since there are no available data on the sensitivity of this procedure, the experiments recorded in this paper were made.

The reagents employed in this work were of the highest purity obtainable. All the experiments were controlled by blank tests, a fresh blank accompanying each group of tests. Sodium salts were used as these would be found in the "prepared solution."

Procedure.

To the solution† of the acid radical diluted to 5 cc., 0.5 cc. $3N$ H_2SO_4 was added by means of a pipette. Two drops of 0.1 N $KMnO_4$ were then added with a medicine dropper. The presence of reducing radicals was indicated by the bleaching of the potassium permanganate. If no bleaching took place in the cold, the solution was heated. The amount of acid used was sufficient to allow reduction and keep manganese in solution. The quantity of potassium permanganate was sufficient in the absence of reducing agents to give a decidedly pink colour to the solution and at the same time was small enough to be bleached completely in the presence of small amounts of reducing substances. The following table gives the results obtained.

* This solution will obviously be the so-called "prepared solution" from which the reducing metals such as stannous and ferrous salts have been removed by the usual sodium carbonate treatment.

† If the prepared solution is used, it first must be neutralised with H_2SO_4.

Reduction of Permanganate by Acid Radicals.

	1 mg. Cold	1 mg. Hot	10 mg. Cold	10 mg. Hot	100 mg. Cold
Arsenite	+[1]	+	+	+	+
Thiosulphate[3] [4]	+	+	+	+	+
Sulphite	+	+	+	+	+
Sulphide	+	+	+	+	+
Iodide[5]	+	+	+	+	+
Bromide	+	+	+	+	+
	3 min				
Thiocyanate...	+	+	+	+	+
	2 min	1 min	1 min		
Ferrocyanide	+	+	+	+	+
Cyanide[6] ...	–[2]	–	–	+	+
				5 min	
Nitrite	+	+	+	+	+
Oxalate	–	+	–	+	+
					8 min
Tartrate ...	–	+	–	+	+
					5 min
Chromate[7]					–
Borate[7]	–	–	–	–	–
Arsenate ...					–
Phosphate[7] ..					–
Sulphate[7] ..					–
Acetate[7]					–
Fluoride[7] ...	–	–	–	–	–
Carbonate[7] [8]					–
Chloride[7] ...					–
Chlorate[7] ...					–

[1] A plus sign indicates bleaching in less than 1 minute.

[2] A minus sign indicates no apparent bleaching.

3 The thiosulphate solution oxidised on standing in contact with air, as shown by the separation of sulphur. In each experiment fresh solution was used before such separation had taken place.

[4] Heated specimens showed a greater separation of sulphur.

[5] In each case the amount of iodine liberated, as shown by the colour, was the same.

[6] When the permanganate was added before the addition of the acid, it was bleached in all cases with the separation of MnO_2.

[7] The 100 mg. portions also were heated.

[8] The permanganate was added before acidifying.

Conclusion.

From an inspection of the table it can be seen that if the test is carried out as described and no bleaching of the permanganate takes place, the following acid radi-

cals (in amounts greater than 1 mg. in the sample taken) may be assumed to be absent; arsenite, thiosulphate, sulphite, sulphide, iodide, bromide, thiocyanate, ferrocyande, nitrite; and more than 10 mg. each of oxalate and tartrate. If on heating there is still no bleaching the following may also be assumed to be absent: oxalate, tartrate, and more than 10 mg. of cyanide.

The College of the City of New York.

CATALYTIC OXIDATION OF NAPHTHALENE.

By Tokishige Kusama.

The paper is a report on the oxidation of naphthalene in gaseous phase by means of V_2O_5 used as the chief catalyser. Generally, it is difficult to derive an intermediate product by catalytic oxidation in gaseous phase. The causes for this circumstance have been experimentally sought and found to be the excessive quantity of the reaction heat and the chemical degeneration of the catalyser during the reaction. It is, therefore, necessary to properly manage the heat of reaction in the first place, and so to control the reaction as to be effected below the combustion temperature of phthalic anhydride, which is the substance aimed at. For this purpose we adopted five different methods, among which the following may be mentioned as the most effective.

1. The interposition of metal wires or plates which are good conductors of heat, and at the same time not susceptihle to the reaction, thereby conducting the heat of reaction all-round and keeping the temperature constant.

2. The reaction tubes are immersed in a bath in which a fluid is employed, whose specific heat or latent heat of vaporisation is very large.

3. The volume of the catalyser is much augmented by admixture of some substances not susceptible to the reaction, thus enlarging the area from which the heat radiates outwards from the reaction tube.

In the second place, the complete combustion of naphthalene evoked by the degeneration of the catalyser is avoided by using a suitable promoter. The reaction is accelerated by an oscillation of vanadium oxide as follows:—

$$V_2O_5 \rightleftarrows V_2O_4 \rightleftarrows V_2O_3 \rightleftarrows V_2O_2 \rightleftarrows V_2O;$$

and those below V_2O_3 being basic oxides, the phthalic acid is decomposed on account of their basic property. This was ascertained by the decrease of the yield by addition of a basic substance. On the other hand, the yield is improved either by adding an acidic oxide as a promoter into the catalyser, or by mixing an acidic substance in the reacting gases. An acidic oxide of Mo, W, Ce, Cr, U, etc., is preferable, or such a substance as SO_2 mixed in reacting gases increases the yield. Since the oxide used as a promoter also behaves like V_2O_5, taking several forms of oxides of basic nature, it is necessary to use two or three kinds instead of a single substance for the promoter. The action of the promoter takes place in the following way:—V_2O_5 by oxidising naphthalene loses its oxygen, becoming a lower oxide, thus combining with the newly produced phthalic acid, which however, is prevented by using an acidic substance as the promoter, since even if any lower oxide of vanadium be produced, the promoter combines wth it and not with phthalic acid. If the promoter is not used, the reaction takes place very briskly, and when V_2O_5 presenting strong basic power catches phthalic acid, it acts as a poison and stops the reaction wholly sometimes, the activity not recovering thenceforwards. When water vapour is used, the yield is fair and a large quantity of benzoic acid is obtained. This is again due to setting free of benzoic acid produced and just stopping the decomposition there, by the combination with the basic oxide of the catályser. In short, we have ascertained, that when the product aimed at is acidic, an acidic substance also is most suitable for the promoter.

—*The Bulletin of the Institute of Physical and Chemical Research.*

AMERICA THE LAND OF GAS.

Remarkable Figures.

Gas undertakings throughout the country report a constantly growing use of gas for cooking and heating purposes, due largely to the development of modern gas fires and self-regulating ranges for domestic heating and cooking purposes.

It has been left, however, for America, commonly regarded as the home of everything electrical, to provide the most striking example of the increased popularity of gas. Official figures show that of the 27,850,000 families resident in the United States, 12,970,000 cook by means of gas, 8,290,000 by means of coal or wood, and only 6,590,000 by electricity. No fewer than 14,477,000 gas ranges are now in use, an increase of a million and a half over the figure for 1927.

THE MAINTENANCE OF CHEMICAL PLANT AND MACHINERY.

By C. W. BRETT.
(Managing Director, Barimar Ltd.,
Scientific Welding Engineers.)

The discoveries in the vast field of chemistry which, during the last twenty years, have followed upon indefatigable and intensive research, inevitably led to the introduction on a large scale of machinery whereby the products of the experimental laboratory might be commercialised and economically manufactured in sufficient quantity to supply the newly created demand.

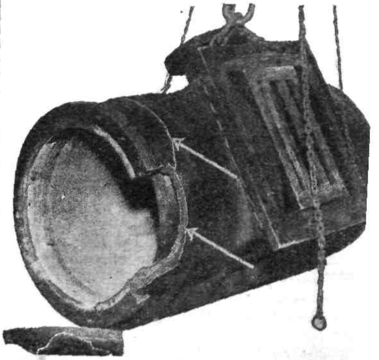
The advent of mechanical devices in this industry, however, produced a problem which demanded scientific solution. The question centred about the rapid and economic repair of the units used in production. In the past, of course, the difficulty was overcome by the simple—though reasonlessly expensive—process of replacing a worn or broken device by a new one. Nowadays, however, such methods are indefensible, the remarkable development of the high temperature treatment of industrial metals has made it wholly unnecessary to cast aside a device which through fracture, wear-and-tear, corrosion, vibration or other injury has become inefficent.

Manifestly, the reconditioning of power or producing units by means of what is often, though erroneously, described as autogenous fusion is not, in the fullest sense, so simple a matter as is commonly supposed. The invention and widespread use of high-grade steel alloys, with their complex and delicate molecular or crystalline structure, has added enormous and innumerable difficulties to the process of welding. Indeed, the craftsman who attempts the reconstruction of modern machinery stands little chance of success unless he has a comprehensive knowledge of metallurgy and thermics.

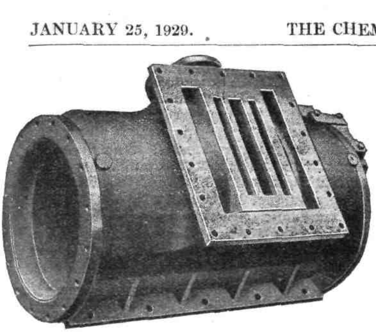
Steels containing varying proportions of Vanadium, Chromium, Zirconium, Tungsten, etc., to mention only a few of the alloys which now enter largely into the composition of high-speed steels, cannot safely or profitably be subjected to temperatures ranging from 2,000 to 5,000 degs. Fahr. without proper safeguards. Again, the successful employment of welding depends upon the careful selection of the special process best adapted to given conditions and materials. In some cases the oxy-acetylene process is to be preferred; in others the electric arc, thermit, or one or other of the half dozen methods now used by the specialist. To treat Molybdenum or Cobalt steel in precisely the same manner as low carbon iron is to court disaster through the destruction of the material handled.

Fusion, or the junction of two pieces of metal by melting is a comparatively simple matter, and it is this fact that enables those who lack proper qualifications to undertake work for which they are entirely unfitted, with the inevitable result that hundreds of pounds are wasted and much costly plant destroyed. Unfortunately superficial examination does not reveal the structural damage done, and the trouble is not detected until the member or component dealt with breaks, or until a radiograph has been taken showing the mischief set up internally.

From this it will be seen that the common assumption that any clever mechanic can, with a little practice, be confidently entrusted with the reconditioning of an out-of-action- unit, is wholly erroneous. Welding—by whatever process effected—is like all other technical processes in that it demands skill, experience and judgment if the result is to have an economic value. At each stage the welder is confronted by many problems which call for prompt solution, and unless he is possessed of the requisite knowledge his best efforts must assuredly end in failure.



A badly-broken steam engine cylinder.



The identical steam engine cylinder, perfectly repaired at small cost, by Scientific Welding within a few days.

Coming to the employment of scientific welding in relation to the rehabilitation of worn, cracked or fractured units used in the manufacture of chemicals, the following incomplete list will serve to indicate its utility in this direction : All metal parts of furnaces, boilers, power units (steam, electrical, petrol or gas driven), engine house fittings, equipment and tools, retorts, gas containers and producers, compressors used for all purposes, filters, pulverisers and granulators, vats, tuns, cooling tanks, centrifuges, separators, fans, blowers, evaporators, crucibles, ovens, incinerators, cylinders, hoppers, containers, mixers, presses of all types. All metal parts of transport units, including cylinders with smashed bores—no regrinding, same pistons, bore not enlarged ; broken crankcase, gearboxes, and axle cases in cast iron or aluminium. Steel crankshafts, cam shafts, axle shafts, chassis frames, roadwheels, etc. Scored cylinders (injured by loose gudgeon pins) repaired and existing pistons fitted. Steel mudguards welded and straightened, wrecked radiators and battered lamps.

In other words, there is scarcely a member or component fabricated of whatsoever metal which cannot be reconstructed equal to new, irrespective of its condition or age.

One notable feature of scientific welding not possessed by any other process of repair is that it is possible to build up worn or corroded parts to their original dimensions, or, if desired, to give them additional strength. If, for example, experience shows that a certain member or component is liable to recurrent breakage (either through inferior or unsuitable material, defective design or other causes) the faulty portion can be reinforced by the welding-in at the weak spot a steel plate, or, when practicable, adding to the thickness of the metal.

From the point of view of economy it may be stated without qualification that the cost of repair by scientific welding is usually a small fraction of the cost of replacement, while the saving in time is frequently in the region of 75 per cent.

These facts — which are susceptible of fullest proof—indicate that scientific welding represents the ideal method of reconditioning and maintaining all types of mechanical plant at the highest pitch of efficiency with minimum outlay and loss of time ; but such a result, it should be remembered, is only possible when the work is placed in the hands of a specialist. An unqualified or incompetent craftsman, armed with a welding torch, can do more harm to a costly machine in half an hour than can be put right in a week. Indeed, it would be no more absurd for a manufacturer to entrust the production of, say, dicyandiamide or diethylmalonylurea to a druggist's junior assistant, than to hand over valuable plant or machinery to the tender mercies of an inexperienced welder. In neither case would satisfactory result be obtained.

The economic value of a scientific process is dependent upon the degree of knowledge and skill which are combined in its application.

REGISTRATION OF CHEMISTS.

(Abstracted from the Journal of The Institute of Chemistry.)

PRELIMINARY.

In dealing with the question of Registration it is instructive to study the position of other professions in this connection. In discussions on the subject, frequent reference has been made to the conditions which obtain in the medical profession, for which the registration authority is the General Medical Council, which was first constituted under the Medical Act, 1858. The Medical Register for 1928 contains the names of rather more than 50,000 persons practising in Great Britain and Ireland and over 3,000 abroad. The General Medical Council, as constituted under the Medical Act, 1886, consists of members appointed by universities having medical faculties, members appointed by medical corporations, such as the Royal Colleges of Physicians and Surgeons, members appointed by His Majesty

the King in Council, and members elected by the profession as a whole, together with three dentists who are appointed for dental business. The Council meets twice, and its Executive Committee three or four times, annually.

A memorandum prepared by the Registrar of the General Medical Council (published in March, 1928, by Constable & Co.), states that the General Medical Council is entrusted with making and keeping the Medical Register, which contains the names of those alone whom the law declares to be duly or legally qualified. "The Council has to see that the tests of professional fitness actually applied by the examining bodies to aspirants for registration are sufficient," and "that no registered person, who by crime or misconduct has become unworthy of the legal status which registration confers, shall remain on the Register." "It is a Council of Education and a Board of Registration ,under the supervision of the Privy Council, which may direct it to amend its errors, if any, or supersede it if it persists in them." It constitutes "a Professional Court of Justice for the trial and determination of grave charges brought against registered practitioners in their professional capacity," and its judicial decisions in all cases within its competence are held to be final on questions of professional conduct. The Council has no jurisdiction over the Licensing Bodies in regard to the withdrawal, under their by-laws, of qualifications from their own members or licentiates. (Many of the Universities, it may be noted, have no power to withdraw degrees once conferred.) The Licensing Bodies are not bound either to await or to follow a decision by the Council, and since a practitioner must be in the possession of at least one qualification for registration, in the event of his name having been removed, the Council has no power to restore it unless he is in fact qualified.

The General Medical Council is not concerned with rates of pay, or hours of work, or disputes with employers, or theories of practice; it offers no pecuniary benefits, and it can be sued in the courts like any other corporation. It exists in fact for the protection of the public, not of the profession. It is "neither a parliament for making professional laws nor a union for protecting professional interests." Its purpose is "not to promote the welfare of professional men or professional corporations," but simply to protect the interest of the public, because it is expedient that persons requiring medical aid should be able to distinguish qualified from unqualified practitioners. It is the machinery for hall-marking the qualified practitioner in order that he may be easily recognised when his services are required; but the public are free to seek "medical aid" from the unqualified practitioner if they choose to do so. The unqualified practitioner is free to practise for gain among those who choose to consult him; but the fact that he is not registered certainly militates against his obtaining practice. He must not pretend that he is registered; he cannot use the courts for the recovery of his charges, or give a valid certificate for sickness or death, or prescribe certain dangerous drugs; but, except for such inconvenient disabilities, he is not affected by the law.

The qualified man, however, enjoys a definite legal status and official recognition, although he is subject to educational and disciplinary control. In some places abroad, even in some parts of the King's Dominions, an unqualified person who habitually and for gain holds himself out as practising any branch of medicine or surgery is liable to penalties; but legislation restricting the practice of medicine and surgery in this country to qualified persons only is not at present regarded as either probable or possible.

In discussions on registration, reference is also frequently made to the British Medical Association, which was founded in 1832, and has a membership of over 30,000, or about three-fifths of those whose names are on the Medical Register. The object of the Association is "to promote the medical and allied sciences and maintain the honour and interests of the medical profession." Its activities, however, are scientific, ethical, medico-political, and social; it is very largely recognised as the representative organisation of the profession; it has branches and divisions throughout the Empire, publishes a weekly journal, conducts an Information Bureau for assisting medical practitioners in clinical and scientific as well as medico-political matters; but it is not the Registration Authority.

The position in respect of Veterinary Practice is much the same as that of medicine; the title Veterinary Surgeon or Veterinary Practitioner or any title which may reasonably cause any person to believe that the user is a registered veterinary surgeon is forbidden to any person not so registered.

Restrictive registration is in some respects more complete under the Dentists Act, 1921, the practice of dentistry by unregistered persons being prohibited, so that any person who acts in contravention of this prohibition is in respect of each offence liable on summary conviction to a fine not exceeding £100; but a registered medical man may practise dentistry and also a duly registered pharmaceutical chemist, or druggist, where the case is urgent and no registered medical practitioner or registered dentist is available and the operation is performed without the application of any general or local anæsthetic. The performance is allowed, also, in any public dental service, of minor dental work by any person under the personal supervision of a registered dentist, and in accordance with conditions approved by the Minister of Health after consultation with the Dental Board. The Dentists Act, 1921, provided, however, for the admission to the Register of persons (1) of good character, who (2) had been engaged for five or seven years immediately preceding the commencement of the Act as their principal means of livelihood in the practics of dentistry in the British Islands, or who were admitted to the membership of the Incorporated Dental Society not less than one year before the commencement of the Act, and (3) had attained the age of 23 years before the commencement of the Act. The Act also provided under certain conditions for the admission to the Register of dental mechanics who within 10 years from the commencement of the Act pass the prescribed examination in dentistry. The Dentists Act, 1923, made certain special provisions for persons who had neglected to apply for registration and for persons who had served during the war in His Majesty's Forces, provided they passed the prescribed examination. (While their number will continuously decrease, a period of half a century must pass before the Dentists' Register will cease to contain the names of persons who have not become qualified in the now established orthodox manner.)

In Pharmacy the object of restrictive legislation is to regulate the sale of poisons for the proper protection of the public.

Restrictive registration is complete so far as the Law (barristers and solicitors) is concerned. The profession of patent agent is restricted under powers vested in the Board of Trade, the Register being kept by the Chartered Institute of Patent Agents, although all registered patent agents are not members of that Institute. Regulation of the profession of architecture has recently been considered in Parliament, but up to the present without result. Fellows and Associates of the Royal Institute of British Architects are entitled to use the term "Chartered Architect," and the expression "Chartered" is similarly restricted to members of the Chartered Institutes of Accountants, Civil Engineers, Electrical Engineers, Patent Agents, Surveyors, and Secretaries.

With these examples in view, the position of the profession of chemistry may be considered, bearing in mind what has already been done by the Institute during the past 50 years to promote the organisation of qualified chemists, to maintain their efficiency, and to create among them a code of professional procedure.

RECORD YEAR OF PATENTS IN 1928.

Highest Figures Ever Reached.

It is highly satisfactory to be informed by Messrs. Rayner & Co., the well-known London Patent Agents, of 5, Chancery Lane, W.C.2., that last year will hold the record which reached the high total of 38,935 against the previous record of 36,680 in the year 1920.

This is a matter of sincere congratulation showing clear signs of our industrial progress which should augur well for better trade for 1929.

The "wireless" world and the transmission of both sound and vision as represented by the gramophone and the films, are responsible for a large portion of the increase, but the records show a general improvement in all trades including the art and industry of Chemistry which permeates nearly every section of our commerce, and where invention is probably more in evidence than any other science.

It is now well recognised that progress by Inventions must continue and increase and the record Patent Office figures of last year will be a much needed encouragement to our inventors as upon their endeavours and achievements greatly depend the commercial success of our industries in their competition with the world's markets.

GENERAL NOTES.

BOARD OF TRADE ANNOUNCEMENT.

Safeguarding of Key Industries.

A representation has been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding paraphenetidine.

Section 10 (5) of the Finance Act, 1926, is as follows :—

"The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such period as may be specified in the Order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication on the matter should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, London, S.W.1., within one month from the date of this notice.

15 January, 1929.

ETABLISSEMENTS KUHLMANN SHARES LISTED ON AMSTERDAM EXCHANGE.

Shares of the Etablissements Kuhlmann, the great French chemical firm were, we understand, listed on the Amsterdam Exchange. This development marks a new step in the progress of the company, whose continued expansion during the last five years has paralleled the growth of the German Dye Trust (I. G. Farbenindustrie) and Imperial Chemicals in this country.

The capital of Etablissements Kulhmann, which has been established for over a hundred years, was increased a year ago from Frs. 200,000,000 to Frs. 250,000,000 by the authorisation of 200,000 new shares, of which 50,000 were taken up by an American consortium headed by Dillon Read & Co., of New York. During 1928 the company's sales of fertilisers and inorganic chemical products increased 20 per cent., and dyestuffs and organic products, 25 per cent. One-third of the company's output was exported.

IMPERIAL CHEMICAL INDUSTRIES LIMITED.

The Directors of Imperial Chemical Industries Limited, announce that they have appointed to the Board of the Company, and to its Executive Committee, Mr. J. H. Wadsworth, who has been Secretary of Imperial Chemical Industries Limited, since its incorporation.

Mr. P. C. Dickens has been appointed Secretary of the Company in the place of Mr. Wadsworth.

OVERSEAS TRADE.

The Officer-in-Charge of His Majesty's Trade Commissioner's office at Wellington reports that the New Zealand Government Railway Department is calling for two tenders to be presented in Wellington by the 5 June for the supply of (1) lubricating and gas-making oils, and (2) locomotive bearing-oil, respectively.

Firms desirous of offering oils of British manufacture can obtain further particulars of these calls for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number BX. 5013 should be quoted.

EGYPT WANTS WOOD NAPHTHA.

The Commercial Secretary at Cairo (Mr. R. M. A. Turner, O.B.E.) reports that the Egyptian Customs Administration is calling for tenders to be presented in Alexandria by the 15 March, for the supply of 135,000 kilos of wood naphtha (wood spirit).

Firms desirous of offering wood naphtha can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference No. BX. 5006 should be quoted.

TENDER FOR DISINFECTANTS FOR EGYPT.

The Commercial Secretary at Cairo (Mr. Richard Turner, O.B.E.) reports that the Egyptian Department of Public Health is calling for tenders, to be presented in Cairo by the 10 February, 1929, for the supply of disinfectants for medical and general purposes reguired during the year ending 30 April, 1930.

Firms desirous of offering disinfectants of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number BX. 5030 should be quoted.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Papers read on Thursday, January 17 :—

The Charge of an Electron. By PROF. A. S. EDDINGTON, F.R.S.

The Thermionic Emission Constant A. By R. H. FOWLER, F.R.S.

The main object of this paper is to apply Nordheim's theory of the emission coefficient of electrons from metals so as to explain the remarkable relation between the constants A and χ of the thermionic emission formula, first recorded by O. W. Richardson and recently reformulated by Du Bridge. This theory regards the emission as due to the passage of electrons through simple surface potential steps and double layers, to be calculated according to the wave mechanics. We conclude that the theory gives a completely satisfactory account of the facts whenever it can be properly applied. The necessary conditions for its proper application are formulated. Certain apparent discrepancies in absolute magnitude between the observed and theoretical values of A are left outstanding and it is necessary to discuss possible explanations of these in some detail. It is concluded that though their precise cause cannot yet be specified thev can certainly be explained and their existence is in no way antagonistic to the main theory.

The Tensorial Form of Dirac's Wave Equations. By G. TEMPLE. Communicated by S. Chapman, F.R.S.

Darwin's transformation of Dirac's wave functions is shown to be incompatible with the theory of relatiivty. Dirac's wave equations are cast into tensorial form, from which are deduced the Lagrangian function, the charge and current tensor, the magnetisation and polarisation tensor, some associated quadratic invariants.

Papers read in title only :—

On the Analysis of the First Spark Spectrum of Sulphur. By D. K. BHATTACHARYYA. Communicated by M. N. Saha, F.R.S.

An attempt has been made to analyse the first spark-spectrum of sulphur, using the data of Eder and Valenta between λ 8028 to 5819, and of certain observations of Keeler and Lockyer regarding the occurrence of S+-lines in stellar spectra. The 4 P-(4D, $\overline{4P, 4s}$) combinations due to 4 M_2 (N_1←N_2) transition have been definitely identified, with the aid of Saha and Majumdar's method of horizontal comparison. The spectrum in the red region up to λ 7715 was also photographed, using neocyanine plates and a Wood type of discharge tube. A large number of new lines have been obtained, showing certain intercombinations. A by-product is the discovery of a band-system in the red, seemingly analogous to atmospheric bands of oxygen.

Effect of Combined Electric and Magnetic Fields on the Helium Spectrum. By J. S. FOSTER. Communicated by A. S. Eve, F.R.S.

Parallel electric and magnetic fields are applied to a helium souree, and the light analysed by a prism of spectrograph of high dispersion. The effects in the parhelium and orthohelium spectra are clearly additive in the sharp and principal series, and for the components of the diffuse lines which are resolevd. The magnetic separation is independent of the magnitude of the Stark-effect. Certain Stark components, which were known to vanish in moderate fields, now reappear under the action of stronger fields, as predicted in the quantum mechanical explanation of the Stark-effect for helium.

The Ultra-Violet Spectrum of Magnesium Hydride, I. By R. W. B. PEARSE. Communicated by A. Fowler, F.R.S.

In addition to the well-known visible (α) band system in the spectrum of MgH, two others (β and γ) are found in the ultra-violet. The β-system is represented by a strong band at λ 2430; while the γ-system covers the range λ 5500-λ 2300. The λ 2430 band has been analysed and found to contain a P, a Q and an R branch, each composed of lines which are apparently single, but are probably doublets resolved only in the region of the band origin.

The rotational analysis shows that the final state for the λ 2430 band is identical with the final ^2S state for the O, O band (λ 5211) of the α-system, and that the initial state is of the same type as that of the α-system, namely ^2P. The α-system is the MgH analogue of the " D " lines of Na, the "comparable atom," while the β-system corresponds to the second member of the $^2P \longrightarrow {}^2S$ series of Na, λλ 3302.34, 0.94.

The λ 2430 band is the O, O band of the β-system. The Q-heads of other bands of the same system bave been detected and measured under low dispersion, and values of initial and final vibrational quantum numbers n', n'' assigned. This analysis also

points to the final state being the same for β as for α system.

Stark-Effect in a Violet Region of the Secondary Spectrum of Helium. By J. K. L. MacDonald. Communicated by A. S. Eve, F.R.S.

Stark and five Japanese investigators, Kiuti in particular, have reported on the Stark-effect in various lines throughout the secondary spectrum. A few regularities have been found, and recently there has been considerable theoretical development, so that quite broad application for the data may be expected.

In the writer's work, effects for twenty lines are observed in the region 3980-4080 A. The Lo Surdo type of discharge tube is used; displacements are measured at a field strength of 95,000 volts per cm. A three-prism glass spectrograph of excellent resolving power is employed. An important point is the resolution of certain apparently complex effects into simple displacements of closely lying lines; five of the normal lines of the list appear to have a very close structure not previously reported. A peculiar fact is that the lines in the two halves of the region investigated are displaced in opposite directions. There is slight overlapping of the two groups. Comparison made with effects reported by other observers for six of the lines shows definite disagreement in most cases.

Relative Intensities of Stark Components in Hydrogen. By J. S. Foster and M. L. Chalk. Communicated by A. S. Eve, F.R.S.

This is a report of a quantitative investigation of the relative intensities of the stronger Stark components in the first four members of the Balmer series. Three modifications of the Lo Surdo source are described and illustrated, and are found to be suited to the methods of measurement employed. In the first method, the slit is evenly illuminated by a source in a uniform field, and the intensities determined by the direct use of a neutral wedge placed in front of the slit. In the second, a normal Lo Surdo photograph is accompanied by a supplementary wedge photograph of a continuous spectrum, which is used to calibrate the plate, and indirectly to give the intensities from readings on a Moll photometer. On a few points the results differ, even in a qualitative way, from Stark as well as from earlier applications of theory; but in all cases they agree within experimental error with the new calculations by Schrödinger. This indicates that the fine structure has little effect on intensities in high fields.

The Thermal Conductivity of Solid and Liquid Sulphur. By G. W. C. Kaye, and W. F. Higgins. Communicated by Sir Joseph Petavel, F.R.S.

The thermal conductivity of sulphur has been determined over a range of temperature of from 20° C. to 210° C. by means of a "plate" method using a small temperature drop across the specimen. The temperature range includes the transition point from rhombic to monoclinic sulphur (95° C.), the "natural" melting point of monoclinic sulphur (115° C.) and the change ponit of liquid sulphur (160° C.). Some observations have also been made on the "plastic" modification. In addition, the experiments show the effect of the previous thermal history on the rates of the several transformations.

On Bromine Chloride. By S. Barrett and C. P. Stein. Communicated by T. R. Merton, F.R.S.

From spectrophotometric observations on the colour changes on mixing carbon tetrachloride solutions of bromine and chlorine, we conclude that in such solutions the two halogens combine to give an equilibrium concentration of bromine monochloride. In equimolecular mixtures about 50 per cent. of the halogens are present as the compound. The same type of colour change, and presumably the same chemical changes, occur when the halogens are mixed as gases, or as solutions in other solvents. The formation of a chemical compound between them is further indicated by the appearance of a new ultra-violet absorption band with its maximum at 3700 A, peculiar to the mixtures, and also by the fact that the colour change in carbon tetrachloride solution takes an appreciable time, a phenomenon difficult to explain on any other basis than that of a slow reaction. The formula of the compound, which is suggested above, agrees with the observation that on mixing chlorine and bromine in the gaseous state the volume change, if existent, is very small.

The Pressure of Gaseous Mixtures. II. By C. W. Gibby, C. C. Tanner and I. Masson. Communicated by F. G. Donnan, F.R.S.

Extending their former work on other gases, the authors have measured the compressibilities, up to 125 atm., of helium, hydrogen, and ten mixtures of the two, at 25°; and of each pure gas and an equimolecular mixture at seven temperatures from

25° to 175°. The results for pv are reliable to $\pm$ 5 in ten-thousand. The experiments are described.

Some Experiments Concerning the Counting of Scintillations Produced by Alpha-Particles. Parts I-III. By J. CHARITON AND C. A. LEA. Communicated by J. Chadwick, F.R.S.

The paper is a description of an investigation of various factors involved in the method of scintillation counting.

Part I.—Determination of the smallest amount of luminous energy perceptible by the eye.

Part II.—Determination of the efficiency of the transformation of the kinetic energy of the α-particle into radiant and luminous energy for various zinc-sulphides.

Part III.—Investigation of the way in which the number of scintillations observed is affected by the numerical aperture of the optical system used.

THE CHEMICAL SOCIETY.

Thursday, January 17.

The Chemistry of the Three-Carbon System. Part XX. Cyclo*pentylideneacetone and* cyclo*pentylidenemethyl ethyl Ketone.* By A. H. DICKENS, W. E. HUGH, AND G. A. R. KON.

It is possible to prepare *cyclo*hexylideneacetone and its βγ-isomeride in a state of purity and a study was made of their interconversion under the influence of reagents.

The corresponding *cyclo*pentane compounds have also been prepared. These compounds possess a very high degree of mobility and are completely converted into equilibrium mixtures in less than 1 hour in the presence of N-sodium ethoxide at 25° The equilibrium mixture contains 84 per cent. of the ketone I when R = Me and about 89 per cent. when R = Et.

Non-existence of Isomerism Among the Dialkyltelluronium Dihalides. By H. D. K. DREW.

Vernon's "β-base," the parent of the "β-dimethyltelluronium dihalides," is split, by treating its cold aqueous solution with the necessary proportion of hydriodic or hydrobromic acid, into (1) colourless crystalline trimethyltelluronium iodide or bromide, $TeMe_3hal$, which are polar substances; and (2) a white amorphous substance, which is an anhydro-derivative of tellurium methyl trihydroxide, $TeMe(OH)_3$. The latter is converted by the requisite halogen acid into crystalline methyltelluronium tri-iodide or tribromide, $TeMehal_3$, which behave as non-polar substances. The "β-base" is therefore not $TeMe_2O$, but the complex anhydride Me_3Te-O-$TeMe(O)$. It is produced from an anhydride of the α-base, by the migration of a methyl group as in, *e.g.*, the pinacone-pinacoline change. Either of the trimethyltelluronium halides combines with a molecular proportion of either of the methyltelluronium trihalides, yielding a coloured crystalline salt in each case. The following have been prepared: (*a*) $TeMe_3I$, $TeMeI_3$, greenish-black; (*b*) $TeMe_3Br$, $TeMeI_3$, purplish-red; (*c*) $TeMe_3I$, orange-brown; (*d*) $TeMe_3Br$, $TeMeBr_3$, yellow. (*a*) and (*d*) are identical, respectively, with Vernon's "β-di-iodide" and "β-dibromide." The "β-dihalides" are therefore not isomeric with the α-compounds, but are salts having the general formula : $\overset{+}{Me_3Te} \ldots \overset{-}{TeMe(hal)_4}$ or $\overset{+}{Me_3Te}$—$\overset{-}{TeMe(hal)_3} \ldots hal$.

It is concluded that there are no grounds for regarding the space distribution of the valencies directed to the tellurium atom as being other than tetrahedral.

Indian Turpentine from Pinus *longifolia Roxb. Part V. The Oxidation of* d-Δ^3-*carene with Beckmann's Chromic Acid Mixture.* By C. S. GIBSON AND J. L. SIMONSEN.

The action of Beckmann's chromic acid mixture on *d*-Δ^3-carene has been examined. The main products of the reaction were *l-trans*-caronic acid and terpenylic acid; *cis*-caronic acid, terebic acid, dimethylmalonic acid and *d*-homoterpenyl methyl ketone were formed in small amounts. Attention is directed to the possible significance of the formation of *l-trans*-caronic acid on the configuration of the terpene. Treatment of the hydrocarbon with sulphuric acid in acetic acid solution affords a diterpene.

The Enzymic Synthesis of Hydroxyethylphosphoric Acid. By H .D. DAY.

The synthesis of the monophosphoric ester of ethylene glycol may be smoothly accomplished at 38° by the catalytic action of a phosphatase preparation derived from duodenal mucosa on a mixture of the pure glycol and aqueous sodium phosphate solution. The ester prepared in this way has been isolated and identified in the form of the crystalline barium salt.

SOCIETY OF GLASS TECHNOLOGY.

The 112th meeting of the Society of Glass Technology was held in University College, London, on Wednesday, December 19, 1928, Mr. W. Butterworth, Senr., M.A., President, in the chair. The following papers were communicated :—

A Brief Outline of the History, Development and Methods Employed in the Manufacture of Laminated Glass. By W. R. Lyttleton (Works Director of the Triplex Safety Glass Co., Ltd.)

(1) History and Development. — The principle of securing a tough material between two hard and relatively brittle sheets had long been known for decreasing splintering under impact. One of the pioneers to manufacture this type of glass was an Englishman, Woods. His efforts in 1905 were not wholly successful in marketing the product. About 1910, a Frenchman, Benedictus, met with more success, and La Societe du Verre Triplex, which manufactured his article is still in business. Similar efforts were made in America about the same time. Since the war, many firms in England and America, a few in France and Germany, and one in Czecho-Slovakia have manufactured this strengthened glass. The methods used varied considerably.

(2) Manufacture. — A layer of nitro-acetate cellulose, as transparent and free from cloud or any defects as possible is securely fastened to glass sheets. In order to give long service an adhesive cement is employed to hold the layers together. In one method of manufacture, in order to obtain a perfectly clean surface on the glass plates they are cleaned with rouge and washed in running water. When dry, the plates are evenly coated with a suitable gelatine solution, then this in turn is dried in warm filtered air. An enamel or varnish is applied to the dry gelatine. Two prepared sheets of glass and a suitable sheet of celluloid are then placed in an alcohol bath at a definite temperature; and assembled as a " sandwich " with the celluloid in the centre. The sandwich is then subjected to pressure in a hydraulic press, air bubbles and excess fluid being pressed outwards. In order to exclude moisture from the adhesives the cellulose is " cut back " around the edges of the glass, and the space is filled with pitch, bitumen, varnish or paint. The laminated glass is then ground, polished and prepared for use in the usual ways. Cellulose acetate and nitro cellulose may discolour and become brittle, but use is made of high boiling point solvents to overcome this difficulty.

A Simple Test for the Detection of Iron in Glass Sands." By J. T. Randall and R. E. Leeds. (Research Laboratories, General Electric Co., Ltd., Wembley).

The test consisted of the heating of the materials in an atmosphere of hydrogen at a temperature of 1,000° C. for half an hour. The iron oxides were reduced, and in the case of a sample builder's sand the resulting iron had been separated by means of a magnet. The materials became much darker in colour after reduction, the presence of iron being easy of detection. It had been found possible to use coal gas in place of hydrogen.

Note on the Reduction of Glasses in Hydrogen. By J. T. Randall and R. E. Leeds. (Research Laboratories, General Electric Co., Ltd., Wembley.)

Experiments were described showing how pieces of glass rod had been heated in an atmosphere of dry hydrogen, over a temperature range of 500° to 1200° C. Exposure for half an hour was sufficient to affect reduction. Glasses containing arsenious lead or ferric oxides became discoloured, the depth of colour depending upon the chemical composition. The application of this test to the detection of impurities in soda-lime-silica glasses was discussed.

THE OPTICAL SOCIETY.

Thursday, January 17.

Papers presented and discussed :—

The Function of the Lens Capsule in the Accommodation of the Eye. By E. F. Fincham.

A Double Reflexion Level. By D. S. Perfect, M.A., D.Sc.

Photographs of Reflexion Caustics. By T. Smith, M.A., F.Inst.P., John S. Anderson, M.A., D.Sc., F.Inst.P., and L. C. Cordle.

INSTITUTION OF MINING AND METALLURGY.

The fourth ordinary general meeting of the thirty-eighth session of the Institution of Mining and Metallurgy, was held at the Rooms of the Geological Society, Burlington House, on January 17. The following paper was discussed :—

The Possibilities of Reviving Non-Ferrous Metallurgy in Great Britain. By William Cullen.

NOTICES OF BOOKS.

Colloid Chemistry — Theoretical and Applied. By Selected International Contributors, collected and editer by JEROME ALEXANDER. Vol. II. *Biology and Medicine.* Pp. 1,029. Price $15.50. New York : The Chemical Catalog Company, Inc., 419, Fourth Avenue, at 29th Street, New York City, U.S.A.

In many branches of science competent authors take diverse views, which truth is accentuated in the present work, which is both important and comprehensive and, we might add, in parts controversial. Controversy is not surprising when the views of so many readers are included between the same covers. As shewn in the preface, there are groups of papers on physicochemical matters, several each on proteins, inorganic ferments and enzymes, protoplasm and cell structure, plants and various medical topics, etc. The views of authors hailing from different countries cannot fail to prove helpful and interesting to readers in arriving at conclusions of their own more or less correct, on the many subjects submitted for discussion. The work gives the reader in one volume views and notions which normally entails the reading of several books. Several of the contributions are of a topical as well as practical nature, such as that on Dust, Fumes and Smoke and their Relation to Health. The papers number close on 60, and there are large numbers of important illustrations, hundreds of references, and comprehensive alphabetical indices to authors and subjects. Altogether the work is of more than passing importance.

Textbook of Inorganic Chemistry. Edited by J. NEWTON FRIEND, D.Sc., F.I.C. Vol. XI. *Organometallic Compounds : Derivatives of the Elements of Groups I-IV.* By A. E. GODDARD, M.Sc., A.I.C., AND DOROTHY GODDARD, M.Sc. Pp. xxviii + 418. London : C. Griffin & Co., 42, Drury Lane. 1928. Price 25s.

With each successive volume of this comprehensive Textbook, eulogies are showered upon the general editor, who indeed is to be congratulated upon the achievements already attained in connection with his task of producing a complete survey of Inorganic Chemistry.

The present volume, on the organometallic compounds, maintains the high standard of thoroughness and excellence that has marked the previous issues. It may at first seem superfluous to describe these compounds in a separate volume, but when it is realised that this concise but tolerably complete account of the organic derivatives of the elements in Groups I-IV of the Periodic Classification occupies some 450 pages, it will be realised that there was a need for such a volume. There are but few, and these relatively unimportant organo metallic compounds of the alkali and alkaline earth metals, but those of magnesium, zinc and mercury are of outstanding importance.

Grignard's magnesium alkyl haloids have been exceptionally useful reagents in organic synthesis since their discovery in 1900, but they find no place in the present volume because they are not actually isolated during the reactions for which they are employed. Zinc alkyls, discovered by Frankland in 1853, were long used in organo-metallic syntheses, but although still of academic importance they are little used to-day.

No less than eight chapters are devoted to the compounds of Mercury. These are arranged in convenient groups, following the homologous series of organic radicals with which they are combined. The use of mercurials in medicine has been responsible for much research work upon these substances.

The authors' own contribution to our knowledge of the organo-metallic compounds appears in Chapter XI, where the compounds of the metals of Group III are described. Their work comprises investigations on the thallium compounds and should be of particular interest to readers of *The Chemical News*, since it was Sir William Crookes who first discovered and isolated that element. The authors have prepared a very large and representative number of thallium derivatives which are described in this section.

The reviewer is best able to appraise the volume from the manner in which the authors have compiled Chapter XIII, which includes the compounds of tin. The compounds of other elements of Group IV, *i.e.*, silicon, germanium, and lead are also described in two lengthy chapters.

The tin compounds, a number of which were described for the first time in *The Chemical News*, include many of exceptional interest although few recent investigators have studied them. Nevertheless the authors have given an admirable and complete survey of the literature dealing with these bodies.

A feature of the volume is the appendix in which the physical constants have been collected together to relieve the text of too many details.

The authors have contributed a valuable volume to Dr. Friend's invaluable series.

J. G. F. DRUCE.

The Origins and Growth of Chemical Science. By J. E. MARSH, M.A., F.R.S., Fellow of Merton College. Pp. x + 162. Price 5s. net. London: John Murray, 50, Albemarle Street, W.1.

The author seeks to prove that chemistry has not (as is sometimes believed) advanced by fits and starts, but has followed a natural evolutionary course, each successive step forward being the logical development of previous progress. In the early history of science frequently the minds of the discoverers were not sufficiently advanced to appreciate the importance of the discoveries or maybe important inventions obtained by accident. Thus the author shews that Robert Boyle was not able to place proper value upon the casual discovery that a metal by heating gave a calx and that by further heating the process was reversed and the calx reverted to the metal. When the discovery was made a century later science was ready for it. It is of course obvious that the author's contention holds good only after the science of chemistry had emerged from the primitive stage, such as that when Boyle and his contemporary chemists were unable to fully appreciate the importance of simple discoveries and inventions. There were then and had been long prior to that period many chemical substances which had attracted special attention, but the knowledge about them and their importance was inchoate. The cumulative efforts of the various pioneer investigators were slowly but surely paving the way for the more solid developments, which have led to the discoveries and inventions of such far-reaching importance as is now seen everywhere. The author very justly stresses the importance of Boyle's discovery that acid and alkali produce a salt and that a salt is composed of acid and alkali. It is natural to expect that many erroneous views on different phases of chemistry were held by the early chemists. The great work done to chemistry by Black, Lavoisier and Kekule is justly extolled. Attached to the work is an exhaustive index, which is of great importance to student or casual reader.

The Gas Journal Calendar and Directory, 1929.

We have to acknowledge receipt of this handsome calendar and diary. There is contained close upon 800 pages, a good deal of useful information, a diary, etc. The price is 7s. 6d., and it is published by Mr. Walter King, Ltd., Gas Journal Offices, 11, Bolt Court, Fleet Street, London.

Forthcoming Events.

THE SIR JOHN CASS TECHNICAL INSTITUTE.

The above Institution announces a course of lectures to be held at the Department of Organic and applied Chemistry, and dealing with "Coal Carbonisation (Theory and Practice)" by H. D. Greenwood, M.Sc., A.I.C.

This course will consist of 12 lectures of an advanced nature, designed to meet the requirements of those interested in Fuel Technology, with special reference to Gas Manufacture and the production of Coke and Smokeless Fuel. The lectures will be held at 7 p.m. on Monday evenings, commencing February 4, 1929. Seven lectures will be delivered before Easter and five lectures after Easter.

SYLLABUS.

The origin and formation of coal.—Microscopic and analytical evidence. Modern theories. Banded constituents of Bituminous Coal. Chemistry of Bituminous Coal.—Treatment with solvents, oxidation, thermal decomposition. Constitution of coal.—Resistant plant tissues, ulmin compounds, resins, etc. Oxidation of Coal.—Spontaneous combustion. Hydrogenation of coal.—Bergius process. Composition and analysis of coal.—Determination of coking properties. Mineral matter in coal.—Coal cleaning processes.

Fee for the course, 15s.

A public Introductory Lecture will be delivered in connection with the above course at 7 p.m. on Monday, January 28, 1929, by F. S. Sinnatt, M.B.E., M.Sc., F.I.C. Admission to this Introductory Lecture is free.

ROYAL INSTITUTION.

Saturday, January 26, at 3 p.m.—Mr. E. Cammaerts: "Flemish and Belgian Art—The Landscape."

Tuesday, January 29, at 5.15 p.m.—Prof. J. S. Huxley : " Evolution and the Problem of Species."

Thursday, January 31, at 5.15 p.m.—Sir William Bragg : " The Early History of X-rays."

Friday, February 1, at 9 p.m.—Prof. J. L. Myres : " Geometrical Art."

Saturday, February 2, at 3 p.m.—Mr. E. Cammaerts : " Flemish and Belgian Art—Genre Painting."

ROYAL SOCIETY OF ARTS.

Monday, January 28, at 8 p.m.—(Cantor Lecture). C. H. Lander, C.B.E., D.Sc., M.Inst.C.E., F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research : " The Treatment of Coal."

Lecture II.—High Temperature Carbonisation Processes and Coke Treatment : Gas manufacture; Purification, blending and sizing; Steaming; Oil injection; Total gasification.

Wednesday, January 30, at 8 p.m.—(Ordinary Meeting.) George Fletcher : "The Shannon Scheme and Its Economic Consequences."

Monday, February 4, at 8 p.m.—(Cantor Lecture. C. H. Lander, C.B.E., D.Sc., M.Inst.C.E.,F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research : " The Treatment of Coal." (Lecture III.) Low Temperature Carbonisation. Liquefaction of coal. Low temperature carbonisation. Internal and external heating. Hydrogenation processes. Synthetic processes. Combustion of oil.

Wednesday, February 6, at 8 p.m.—(Trueman Wood Lecture.) Sir J. Alfred Ewing, K.C.B., M.A., LL.D., D.Sc., F.R.S., M.Inst.C.E. : " The Vibrations of Railway Bridges : An Example of Co-operative Research."

Friday, February 8, at 4.30 p.m.—(Indian Meeting). Captain E. J. Headlam, C.S.I., C.M.G., D.S.O., R.I.M. : " The History of the Indian Marine."

Wednesday, February 13, at 8 p.m.—*(Ordinary Meeting.)* Cecil Hooper, F.L.S. : " The Pollination of Fruit Blossoms and their Insect Visitors."

Monday, February 18, at 8 p.m.—(Shaw Lecture.) Sir Thomas M. Legge, C.B.E., M.D., Senior Medical Inspector of Factories, 1898-1927 : " Thirty Years' Experience of Industrial Maladies." (Lecture I.)

Wednesday, February 20, at 8 p.m.—(Ordinary Meeting.) Major T. H. Bishop M.R.C.S., L.R.C.P., D.P.H. : " The Purification of Water."

Monday, February 25, at 8 p.m.—(Shaw Lecture.) Sir Thomas M. Legge, C.B.E., M.D., *Senior Medical Inspector of Factories*, 1898-1927 : " Thirty Years' Experience of Industrial Maladies." (Lecture II.)

Wendesday, February, 27, at 8 p.m.—(Ordinary Meeting.) A. F. Suter : "Resins."

DEATH OF WELL-KNOWN UNIVERSITY CHEMIST.

On January 13, Dr. H. J. H. Fenton, of Christchurch College, Cambridge, died in a London nursing home at the age of 74. He was a successful lecturer and the author of text books on analytical chemistry.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

281.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Manufacture of solutions of the cinchona alkaloids. January 3rd.

484.—I. G. Farbenindustrie Akt.-Ges. Manufacture of water insoluble azo dyestuffs. January 5th.

158.—Poore, P.—Production of acetic acid, etc. January 2nd.

Specifications Published.

308,184.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture and production of vat dyestuffs.

275,258.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azo-dyestuffs.

303,038.—Gas Light and Coke Co., Adam, W. G., and Potter, F. M.—Distillation of oils, coal tar, and other *liquids.*

302,964.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Reduction of nitro anthraquinones.

Abstract Published.

300,563.—Acetic anhydride.—I. G. Farbenindustrie Akt.-Ges, Frankfort-on-Main, Germany.

In the process of the parent Specification for condensing acetic anhydride from a mixture of its vapour with water vapour by treatment with organic solvents in a column, a dephlegmator is placed at the top of the column, and the organic solvent, such as benzene, toluene, or benzene and trichlorethylene is admitted only at the bottom of the column.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the *Official* Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

SURPRISE.

497,571.—Dyes in class 1.—Wm. Edge & Sons, Limited, 50, Raphael Street, Bolton, Lancashire. January 9th.

SPRAKAR.

497,455.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes.—John Gadd (Colour & Chemical Agencies) Ltd., 126, Bishopsgate, London, E.C.2. January 9th.

PLASMONA.

495,988.—Chemical substances prepared for use in medicine and pharmacy.—Plasmon, Ltd., 66a, Farringdon Street, London, E.C.4. January 9th.

SOCCOLINE.

494,648.—Chemical substances prepared for use in medicine and pharmacy.—Holroyd's Oil and Ceresine Company, Limited, London House, 3, New London Street, London, E.C.3. January 9th.

WANTED, *Chemical News* issue for January 6th, 1928, clean for binding.—Reply to *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

" EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News*.
Price 5s.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the *history of the Sciences makes the book* appeal to the general scientific public. It *is also intended for use in Schools, where the* History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : Merton House, Salisbury Sq.,
London, E.C.4.

Anti-Acid Specialities!

" CONTRACITE "
Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
10, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3590.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES :
Administrative : Central 6521.
Printing Works : Hop 2404.

CONTENTS. PAGE.

Precipitation of Group II Acids (The Chloride Group) in the Presence of Other Acid Radicals ... 65
By Louis J. Curtman and Walter W. Plechner.

Preparation of Pure Silicic Acid Solution by Means of Electrodialysis. I. Electrodialysis ... 67
By Shumpei Oka.

Man's Brain Nature's Masterpiece ... 68

German Trade Treaty with South Africa ... 69

Alleged Discovery of Stone Age Man in Africa ... 70

General Notes ... 71

Czechoslovak Chemical Science ... 72

Chemistry ... 72
By An Ignorant Student.

Sir Arthur Keith Compares the Brain to a Newspaper ... 73

Proceedings & Notices of Societies :—

The Optical Society ... 74

Mineralogical Society ... 75

The Physical Society ... 75

Institute of Chemistry ... 76

Notices of Books ... 77

Forthcoming Events ... 79

New Patents ... 79

New Trade Marks ... 80

PRECIPITATION OF GROUP II ACIDS (THE CHLORIDE GROUP) IN THE PRESENCE OF OTHER ACID RADICALS.

By LOUIS J. CURTMAN AND WALTER W. PLECHNER.

(The College of the City of New York.)

The experiments recorded in this paper were made to provide a procedure for the detection of Group II acids in the preliminary examination of a solution containing the acids of all groups. In the development of such a procedure, it was necessary to determine :

1. The concentration of nitric acid required to keep a reasonable quantity of each of the acids of Group I (the sulphate group) in solution.
2. Whether it is preferable to add the nitric acid before or after the addition of the silver nitrate.
3. How much silver nitrate must be employed to insure the precipitation of at least one milligram of any of the acids of Group II under the conditions of nitric acid concentration established in (1) above.

DETERMINATION OF THE CONCENTRATION OF NITRIC ACID REQUIRED TO PREVENT THE PRECIPITATION OF GROUP I ACIDS.

Two procedures are possible according to whether the nitric acid is added before or after the addition of the silver nitrate. The former causes the following undesirable chemical changes to take place : (*a*) the oxidation of some of the ferrocyanide to ferricyanide ; (*b*) the liberation of free iodine and bromine respectively from any iodine and bromide present ; (*c*) the decomposition of thiosulphate as well as the liberation of volatile acids. On the other haud, the second procedure when carried out in a neutral or alkaline solution will permit no conclusion to be drawn from the addition of silver nitrate until after the addition of nitric acid. Both procedures were investigated. The results are given in Tables I and II.

To determine the quantity of silver nitrate required in this work, the following experiments were performed and repeated. To separate beaker, each containing one milligram of chloride as sodium chloride and 10 cc. of concentrated HNO_3, sufficient water was added to make the total volume in each case 50 cc. Then 1, 3 and 5 cc.,

TABLE I.

SOLUBILITY OF SILVER SALTS IN NITRIC ACID SOLUTION.

100 mg. of acid radical	0% HNO_3	(HNO_3 added after addition of $AgNO_3$.) 5% HNO_3 hot	5% HNO_3 cold	10% HNO_3 hot	10% HNO_3 cold	15% HNO_3 hot	15% HNO_3 cold
Carbonate	–[1]	+	+	+	+	+	+
Sulphate	+	+	+	+	+	+	+
Sulphite	+	+	+	+	+	+	+
Thiosulphate[2]	+	+					
Borate	–	+	+	+	+	+	+
Tartrate	+	+	+	+	+	+	+
Oxalate	–	+	+	+	+	+	+
Fluoride	+	+	+	+	+	+	+
Phosphate	–	+	+	+	+	+	+
Arsenate	–	+	+	+	+	+	+
Chromate[3]	–	+	+	+	+	+	+

[1] Complete solution is indicated by a plus sign. A precipitate is indicated by a minus sign.

[2] A black precipitate formed on standing two minutes due to the formation of silver sulphide.

[3] In addition to the experiments tabulated, the following were performed with chromate:

100 mg. CrO_4 as K_2CrO_4 in 50 cc. of solution to which had been added 5 cc. of 0.25 N $AgNO_3$ was kept in solution by 5 per cent. of HNO_3.

500 mg. CrO_4 as K_2CrO_4 in 50 cc. of solution to which had been added 1 cc. of 0.25 N $AgNO_3$ was held in solution by 5 per cent. of HNO_3.

500 mg. CrO_4 as K_2CrO_4 in 50 cc. of solution to which had been added 5 cc. of 0.25 N $AgNO_3$ was held in solution by 10 per cent. of HNO_3.

respectively, of 0.25 N $AgNO_3$ were added and the mixtures stirred. The quantity of the precipitate was the same in all cases indicating that 1 cc. of $AgNO_3$ gave complete precipitation of 1 mg. of chloride and hence was a sufficient quantity of reagent for such a test.

PROCEDURE.

The results recorded in Table I were obtained by the following procedure. To separate beakers, each containing in a volume of 50 cc. ,100 mg. of the acid radical (as the sodium or potassium salt), 1 cc. of .025 N $AgNO_3$ was added and the mixture stirred. Concentrated nitric acid was then added and for convenience the volumes were 5, 10 and 15 per cent. of the original 50 cc. volume. The amounts of HNO_3 which caused complete solution of the precipitate was noted. Inspection of Table I shows that all the silver salts of the acids of Group I are held in solution under the conditions of the experiment in the presence of 5 per cent. (of the original volume) of nitric acid.

The results recorded in Table II were obtained by a procedure similar to the one described above except that the solution was first treated with a given quantity of HNO_3 and then the silver nitrate added. Again it

TABLE II.

SOLUBILITY OF SILVER SALTS IN NITRIC ACID SOLUTION.

(Solution acidified before the addition of $AgNO_3$.)

100 mg. of acid radical	5% HNO_3 hot	5% HNO_3 cold	10% HNO_3 hot	10% HNO_3 cold	15% HNO_3 cold
Carbonate ...	+[1]	+	+	+	+
Sulphate	+	+	+	+	+
Sulphite	+	+	+	+	+
Thiosulphate[2]	–	–	–	–	–
Borate	+	+	+	+	+
Tartrate	+	+	+	+	+
Oxalate	+	+	+	+	+
Fluoride	+	+	+	+	+
Phosphate ...	+	+	+	+	+
Arsenate	+	+	+	+	+
Chromate	+	+	+	+	+
Nitrate	+	+	+	+	+
Nitrite	+	+	+	+	+
Acetate	+	+	+	+	+
Chlorate	+	+	+	+	+

[1] Complete solution is indicated by a plus sign. A precipitate is indicated by a minus sign.

[2] A black precipitate forms. It is due to the formation of silver sulphide from the decomposition of the thiosulphate by the acid.

was found that the silver salts of all the acids in question were held in solution by 5 per cent. of nitric acid.

For purposes of completeness the acids of Group III, *i.e.*, nitrate, nitrite, acetate and chlorate, were similarly treated. In all cases the silver salts were found to be soluble in neutral as well as in acid solution.

Experiments also showed that 1 mg. each of chloride, bromide, iodide, thiocyanate, ferrocyanide and ferricyanide, and that 2 mg. of cyanide give a precipitate under the given conditions.

CONCLUSION.

The acids of Group II (chloride, bromide, iodide, cyanide, thiocyanate, ferrocyanide, ferricyanide, sulphide), may be precipitated in the presence of the other acid radicals (carbonate, sulphate, sulphite, thiosulphate, borate, tartrate, oxalate, fluoride, phosphate, arsenate, chromate, nitrate, nitrite, acetate, chloride) if a volume of conc. HNO_3 equal to 10 per cent. of the original volume is added.

Further, it is recommended that the following procedure be utilised as a preliminary test for the presence of Group II acids.

To the neutral solution of the acid radicals diluted to 50 cc. add with stirring 1 cc. of 0.25 N $AgNO_3$, then 5 cc. of conc. HNO_3. *Warm and stir. A precipitate shows the* presence of one or more of the acids of Group II, namely, chloride, bromide, iodide, cyanide, thiocyanate, ferricyanide, ferrocyanide, and sulphide.

College of the City of New York.

December, 1928.

CHEMICAL RESEARCH WORK IN MALAYA.

It is officially stated that during the early part of 1928, the study in the Federated Malay States of the amounts of plant nutrients removed from the soil by tapioca made satisfactory progress. The deterioration of jelutong on storage was further investigated, and attention was also given to variations in the moisture content of individual blocks of jelutong. Information was published regarding the utilisation of pineapple-waste and the possibility of producing a potable spirit from this material. Work was commenced on the toxic content of the roots of different species of "tuba."

PREPARATION OF PURE SILICIC ACID SOLUTION BY MEANS OF ELECTRODIALYSIS. I. ELECTRODIALYSIS.

By SHUMPEI OKA.

Preparation of pure silicic acid solution directly from sodium silicate solution by *means of electrodialysis was studied.* Pure sodium metasilicate crystal ,$Na_2SiO_3.9H_2O$) was prepared by twice repeated recrystallisation, and was used as solutions containing 10, 23 or 33 per cent. $Na_2SiO_3.9H_2O$.

Electrodialysis was carried out in a two compartments cell (300 cc, each) using parchment paper as the diaphragm (4 × 10.5 cm.), and purification was completed in a three compartments cell of the same cross sectional area. The voltage was regulated within 10-100 volts to maintain the current at 1, 2 or 4 amperes (mainly 4) as long as possible. When the total resistance became too large to maintain a constant current, then a constant voltage (100 or 150 volts) was applied. Sodium ions in the silicate solution in the anode compartment passed the diaphragm into the distilled water in the cathode compartment by electric current, were discharged and turned into sodium hydroxide. To remove this increasing of sodium hydroxide in the cathode compartment, the distilled water in this compartment was syphoned out at the end of every 30 minutes, and new distilled water was poured in. The removal of sodium from silicate solution was followed by the titration of the syphoned out cathode water, and from which results the apparent current efficiency was calculated.

By treatments of up to about 1000 min., pure silicic acid solutions of 1.39-4.46 per cent. were prepared from silicate solutions of 10, 23 or 33 per cent. The current efficiency was found to decrease gradually with the decrease of sodium concentration in silicate solutions. The total loss of silicic acid during the treatment was found to be 5 to 60 per cent. of the silicic acid in the original silicate solution, which was mainly due to the coagulation of silicic acid on the anode surface and less to the diffusion through the diaphragm. The loss due to coagulation may be much lessened by suitable control of anode current density, good agitation and larger dilution of solution.

Department of Applied Chemistry, Faculty of Engineering, Tokyo Imperial University.

MAN'S BRAIN NATURE'S MASTERPIECE.

Sir Arthur Keith delivered a lecture on the 16th inst., at the Royal College of Surgeons, London. He said that man's brain, with all its failings, represented Nature's masterpiece. Recently a distinguished Viennese neurologist, Professor Constantin Economo, had made a more exact census than any made hitherto of the living units within the cortex, or rind, which was the essential part of the human brain. He found that a European with a brain of 48 ozs., which was a common size, had in the neighbourhood of 14,000,000,000 living units, or neurons, as they were named, in the grey matter, or cortex of his brain.

The average man ,if he were to share out his cortical neurons, could afford to give seven to every human being now alive, and yet have some over. A half-penny postage stamp ,when placed on the surface of the brain, covered an area of cortex which contained a population three times that of Greater London, and it took more than 500 such stamps to cover the whole area of the unfolded cortex.

The wires, or nerve fibres, of the brain were living filaments drawn from the bodies of the neurons. A neuron might have as many as 100 filaments, or wires, attached to it—most of them having terminals in the neighbourhood and usually one long process or filament to make distinct contacts. The degree to which the human brain was "wired" would be appreciated when it was remembered that the bodies of the neurons, or living cells, made up only 4 per cent. of brain matter the filaments being responsible for 70 per cent. Yet the whole of this vast population of neurons, each linked up to many neighbours, both near and distant, was set up successfully in most human heads, and in point of efficiency gave a lead which modern telephone enterprise might well essay. If an engineer thought of an organ wired as the brain was, with messages volleying along each wire at a rate of some 40 or 50 a second, and travelling at a rate of 200 miles an hour, he would have some faint conception of the tide of traffic handled by an efficient brain in the course of a morning.

The neurons of the brain had to be fed regularly and supplied with oxygen every minute of the day and night, and their effete products had constantly to be removed. All these elements had to be built into and supported by a delicate framework known as neurologia. Hence, the brain was not only made up of nerve-work, but of a supporting framework and vascular channels of divers sorts. These, with the blood, cerebro-spinal fluid, and other wrappings of the brain, made up fully 25 per cent. of what filled the skull, and was usually called "brain."

It was plain that mere mass must be a very insecure guide to capacity. A brain might have mass and yet lack organisation or fail in a hundred other ways. A large body, just as a large city, required a more extensive system of communication and government than a smaller body or city; the brain of the elephant and of the whale far exceeded man's brain in mass, but in their case the neurons were of a vegetative order. It was not the number of neurons which mattered, but the extent to which the brain was wired.

Yet the fact remained that mass of brain did usually count. We were all more or less impressed when we sat down to do business with big-headed men, especially if they had also strong bodies and a powerful expression. It was true that some of the extinct races of mankind had large brains, but a survey of all the evidence assured us that man's evolution had been attended by an increase in mass of brain and of intelligence. Intelligence in children usually improved as the brain grew. If the human brain fell short of 32 oz. its owner was an imbecile; to this no exception had been known. Craniometrical investigations had shown that, in all gatherings made up from our leading men, the average mass of brain was distinctly higher than that of groups which represented manual labourers.

BRITISH CAPITAL AND TRADE IN ARGENTINA.

Argentina buys larger quantities of British goods per head of the population than other foreign countries for one fundamental reason—the investment of British capital, states Mr. H. O. Chalkley, C.B.E., British Commercial Counsellor at Buenos Aires. So far as can be judged without looking too far into the future, the feeling of the country, he adds, is still strongly in favour of the participation of foreign capital and the immigration of foreign labour, which, with the magnitude of the plans for the country's development awaiting concerted public effort, indicate expanding trade and investment opportunities.

GERMAN TRADE TREATY WITH SOUTH AFRICA.

OFFICIAL STATEMENT BY FEDERATION OF BRITISH INDUSTRIES.

The Federation of British Industries have had under consideration the proposed Commercial Treaty between the Union of South Africa and Germany.

The Federation do not question the right of South Africa, as a self-governing member of the British Commonwealth of Nations, to adopt any policy which it considers desirable in its own interests. The Federation would, however, point out that grave concern is felt in Great Britain at the terms of the proposed Treaty, which will *result in a foreign country receiving equally* with Great Britain the benefit of all tariff preferences which may be granted in the future. The effect of such a departure in policy on the part of the Union Government is deeply preoccupying British business opinion, and it is feared that the results will be seriously to prejudice trade between Great Britain and South Africa in both directions.

The Federation would point out that the United Kingdom is overwhelmingly the most important customer of South Africa, purchasing as it did in 1927 48 million pounds' worth of South African products, as compared with 18 million pounds' worth purchased by all foreign countries combined. While, as stated above, Great Britain imported 48 million pounds' worth of goods from South Africa in the year in question, the Union imported 32 million pounds' worth of British goods, leaving a balance of trade in favour of South Africa of sixteen millions sterling. In the case of Germany, which is the country to receive the benefits of the proposed Treaty, the exportation of South African goods to Germany was only slightly over 4 million pounds, whereas, the importation of German goods into South Africa exceeded that amount by half a million, thus showing an unfavourable trade balance for South Africa.

The Federation readily recognise the value of the preferences granted by South Africa to U.K. goods. On the other hand they would point out that South Africa receives at present, very substantial counter benefits from Great Britain.

In the first place Great Britain granted to South Africa in actual preferences alone in 1927, approximately half the value of the preferences received by her. In this connection it is interesting to recall that at the last Imperial Conference Mr. Havenga stated that he was the bearer of a special message of appreciation from the Fruit Growers of South Africa, who were reaping the full advantage of the free admission of their dried fruits into England, which is a proof of the appreciation felt in South Africa at the policy at present being pursued by the British Government.

In the second place the British taxpayer is at present providing one million sterling per annum for the work of the Empire Marketing Board, for the purpose of stimulating the marketing and sale of Empire Products, a work which is undoubtedly greatly assisting the South African producer. The Federation has yet to learn that any other Government is taking similar action for the furtherance of South African exports.

Thirdly, capital has been needed and will be needed for the economic development of the Union, and the provision of such capital from British sources has been facilitated and rendered cheaper for South Africa by the operations of the Colonial Stock Act, 1900. *According to the last official return,* existing Loans under this Act amount to over £100,000,000 sterling—a substantial contribution towards the development of South African resources.

Finally the Federation cannot refrain from pointing out that the British taxpayer is called upon to provide for the bulk of the cost of the Imperial Services, which are necessary for the conduct and defence of the Empire as a whole. To take only one example, the U.K. pays £58 million per annum for the upkeep of the Navy which is necessary to safeguard the communications of every part of the Empire with the outside world, and to ensure free access to and from their markets.

The Federation trust that these points will be given the consideration they deserve before a line of policy is definitely adopted which would be extremely harmful to British trade interests, with an inevitable repercussion upon the power of this country to absorb South African products.

In view of the mutual interest in a flourishing reciprocal trade between Great Britain and South Africa the gravity of any step tending to weaken the commercial bonds between the two countries cannot be over-estimated.

ALLEGED DISCOVERY OF STONE AGE MAN IN AFRICA.

Mr. Leakey (leader of the East African Archæological Expedition) considers that glacial periods in Europe were accompanied by severe pluvial periods in Central Africa divided by dry and warm periods. His theory is supported by recent geological researches in the Rift Valley by Dr. Nilsson, of Sweden, who established the existence of a series of beaches hundreds of feet higher than the present lake levels and also indications of glacial caps on the East African mountains down to a height of 10,000ft.

On this assumption, Mr. Leakey believes that he has discovered in what is known as "Gambles Cave" in El Menteita last month a specimen of the earliest predecessor of Aurignacian man yet found. This specimen was intact, except for a pickaxe hole in the skull, and has been removed complete with the surrounding earth. Conditions in the Rift Valley are, in Mr. Leakey's opinion, ideal for the preservation of deposits which established the chronological sequence of the various cultures and their relationship to the different pluvial periods. The skeleton referred to, which was buried with the knees under the chin, was unmistakably of the *Homo sapiens* type. Mr. Leakey's statement that it definitely belongs to the early Second African Pluvial period is very important, as this means that if the African pluvial and the European glacial periods were contemporaneous his discovery is the earliest specimen of modern man yet found, as the Aurignacian is only traceable in Europe at a much later date than the Mousterian. The skeleton was found in association with evidences of a rich industrial development in the form of tools.

Above this, in the deposits of the Third Pluvial period, Aurignacian remains were again found, but associated with pottery, whereas in Europe pottery is not found until much later. Between the two is a layer of Mousterian, suggesting that a primitive people had arrived there and for a short time occupied this cave in the absence of the original occupiers. Nevertheless, the cave reveals a definite cultural development on consistent lines through the three pluvial periods, which development continued till comparatively recent times.

Supporting the evidence of the presence of human beings in Central Africa in the Pleistocene era are the discoveries of the German Professor Hans Reck at Oldoway, Tanganyika, in 1914, which have never been published. Professor Reck found human remains in association with such animals as the three-toed horse, giant-horned sheep, and many others of which 50 per cent. are extinct. Mr. Leakey examined them in Berlin, and declares that to Professor Reck belongs the credit of the discovery of the first Stone Age man in East Africa, though unfortunately the correct pluvial period had not been decided.

Mr. Leakey has every hope of establishing the existence of human beings during the First African Pluvial period in the lower depths of Gambles Cave, and that Kenya is very near the original cradle of present-day man.

RESEARCH FELLOWSHIPS AT THE MISSOURI SCHOOL OF MINES.

In co-operation with the United States Bureau of Mines and the State Mining Experiment Station, the School of Mines and Metallurgy of the University of Missouri offers four fellowships. These fellowships are open to graduates who have the equivalent of a Bachelor of Science degree and have had the proper training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is $800 for ten months beginning September 1, 1929. Fellows pay fees amounting to approximately $42 per year.

Fellows will register as students in the School of Mines and Metallurgy of the University of Missouri, and become candidates for the degree of Master of Science (unless this or an equivalent degree has been earned). Their class work will be directed by the heads of the departments of instruction, but the greater portion of their time will be spent in research work under the direction of the Bureau of Mines staff resident at the School of Mines. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Missouri. For 1929-30 the four fellowships will be granted in the following subjects: "Ore Dressing: Problems in Gravity Concentration." "Flotation, Ball Mining, and Magnetic Concentration."

Applications, with a certified copy of collegiate record, statement of professional experience, and names and addresses of three references will be received up to June 15, 1929. The application should be addressed, Director, School of Mines and Metallurgy, University of Missouri, Rolla, Missouri.

GENERAL NOTES.

NEW ERA FOR BRITISH CANALS.

Linking up the British Systems.
Big Amalgamation.

Britain's inland water transport entered upon a definitely new phase on January 1, when 240 miles of canal came under the control of the newly-formed Grand Union Canal Company.

The Grand Union is an amalgamation of the companies controlling the Regent's Canal, the Grand Junction Canal, the Warwick and Birmingham Canal, the Warwick and Naoton Canal, and the Birmingham and Warwick Junction Canal. The union of these systems represents the first tangible attempt to carry out the recommendations of the Royal Commission on Inland Waterways of twenty years ago. One of the first tasks to which the new authority will apply itself will be the modernisation of plant and gear, a step urged by the Royal Commission as an essential preliminary to any reorganisation of the system.

This big amalgamation is regarded as the most important development of the movement to organise Britain's canal system in effective competition with the rail and road transport systems. Ever since the introduction of steam locomotion, the canals have been fighting a losing battle against the railways. The Grand Union Canal represents the first large-scale effort by the waterways to compete with their formidable competitors. The advent of the internal combustion engine has extended the possibilities of inland water transport, and its successful use on the larger craft seems to foreshadow the end of the horse-drawn vehicle for long-distance tonnage.

As a direct result of the union it will be possible—to give but one example—to ship merchandise direct from Bombay to Birmingham. Cargo will be brought from overseas ports to London, discharged into barges at the Limehouse terminus of the Grand Union Canal, and transported without further change to Birmingham, Coventry, Leicester, or any town or warehouse on the banks of the Union canals.

In anticipation of the revival of canal transport that will follow the scheme of modernisation, inquiries are already being received for vacant canal-sites suitable for warehouses and for wharves, from manufacturers and industrial trading concerns.

There has been a steady increase in the volume of cargo carried on English canals during the past few years. Figures supplied by the Regent's Canal Company show that 732,937 tons of cargo were carried on this stretch of canal last year, compared with 595,556 tons in 1923, notwithstanding the fact that the eight-hour day has curtailed transport working time. The cargo carried was chiefly coal, timber, grain, drugs, chemicals, oils and foodstuffs.

Plans for encouraging the building by the lighterage companies of boats and barges of a size and design more suited to the new conditions will be taken in hand by the Grand Union Canal Compay. With this end in view, a novel step has been taken by the Company in calling in the services of naval architects who are conducting various experiments as to the best type of boat from the points of view of design, construction, stowage of cargo, stability and speed. At present, goods are carried in two types of craft. The barge type is 78 feet long and 14 feet 6 inches wide, and carries 100 tons of cargo; the second type, known as the motor-boat or " butty," for through traffic to, say, Birmingham, is of the same length but only 7 feet wide. This type of boat carries 30 tons of cargo.

The 240 miles of canal to be controlled by the Grand Union Canal Company will link the Thames direct with Northampton, Birmingham and Leicester. These great industrial centres will, in turn, be linked up with Derby, Burton and Nottingham, by means of the Mersey, Derby and Nottingham canal systems. The system will have two direct outlets to the Thames, one at Brentford on an arm of the Grand Junction Canal, the other at Limehouse, which is the eastern terminus of the Regent's Canal and the port of discharge for increasing quantities of goods from the Continental ports.

SCRAP IRON AND STEEL FROM FRANCE.

A total of 30,000 metric tons of scrap iron and steel has again been allocated for distribution among United Kingdom importers during the current year by arrangement with the French Government.

BRITISH IRON AND STEEL OUTPUT IN 1928.

Pig-iron production last year amounted to 6,611,300 tons, as compared with 7,292,900 tons in 1927, while the output of steel ingots and castings totalled 8,525,100 tons, as against 9,097,100 tons.

IS THE ELECTRON A DUMMY?

Before the Royal Society on 17 January, Prof. Eddington read a paper and described a mathematical theorem by which he proposed on theoretical grounds the numerical value of 136 in place of the figure 137.1 derived from experimental data for the familiar formula $hc/2\pi e^2$ in the dynamics of the electron. Passing rapidly from two gold balls on the lecture table to complex equations on the blackboard, he worked out the consequences of revolving the frame of reference, successively in space of two, three, and four dimensions, of two electrons. He showed that in the process the identity, or more probably the identification, of the two electrons became exchanged, and that this took place not at a given moment, when it might be imagined that the label of the one had been transferred to the other, but by a continuous process recalling wave mechanics rather than the mechanics of a particle.

In the subsequent discussion, opened by the President of the Royal Society and joined in by Sir Oliver Lodge, Professor Lindemann, Professor Chapman, and many other physicists and mathematicians, the relative values of theory and experiment were debated, and it was the general opinion that the new "constant" proposed by Professor Eddington opened up conceptions of an unusually important character.

UNITED STATES TRADE AND INDUSTRY.

Trade and industry are more active than a year ago and the commercial situation is considered sound, states a cable received by the London office of the Guaranty Trust Company of New York. Sales of life insurance during the first eleven months of 1928 were 5 per cent. above those of January-November, 1927, the increase being general throughout the country.

The Department of Agriculture estimated the 1928 value of agricultural products at $8,456,052,000 as against $8,522,563,000 in 1927 and $7,793,480,000 in 1926. The 1928 acreage and yields were above the preceding year, but prices were lower.

The steel output in 1928 is estimated to have been over 50 million tons; the previous record was 46,936,000 tons in 1926.

Commercial failures in the week before last were 359, as against 423 in the corresponding week of 1927. Professor Irving Fisher's index of wholesale commodity prices for the week ended 29 December was 97.2, against 96.8 a fortnight before.

CZECHOSLOVAK CHEMICAL SCIENCE.

A new monthly Journal entitled *Collection of Czechoslovak Chemical Communications* has just appeared. Owing to the limited circle of readers who understand Czech, the Czechoslovakian chemists have hitherto published their chief works in journals outside their own country. Nevertheless many important communications still remained untranslated in the archives of the Czech learned Societies or Institutions. This circumstance has not allowed a real international representation of the actual chemical scientific researches carried out in Czechoslovakia. The new Journal will publish in full the more important communications concerning "pure" chemistry, provided they have not previously been published in any widely known language. Besides this, the *Collections* will include a bibliography of all publications of Czechoslovak chemists and reviews of their books.

In the past many Czechoslovak scientists have frequently published articles in the *Chemical News*, indeed, about six contributions from that country appear in this Journal annually. *Nature*, and the Journals of the learned Societies also frequently announce discoveries made by the Professors of the Universities of Prague and Brno. Whilst the new Journal affords a new means of publication it is to be hoped that the old channels will not be discarded.

The annual subscription is 170 Kc., and may be sent to the editors or, where sending abroad is less convenient, to one of the following addresses:—

France: 120 Frs. to Dr. M. Valouch, 22, Rue Pierre Curie, Paris Ve.

Great Britain: £1, to Dr. G. Druce, 26, Heslop Road, London, S.W.12.

Japan: 11 Yen, to Professor Masuzo Shikata, Agricultural Chemical Institute, Imperial University, Kyoto.

United States of America: $5, to Dr. N. V. Emelianoff, Havemeyer Hall, Columbia University, New York.

The Editors and publishers are Dr. E. Votocek, Professor of Organic Chemistry, Czech Technical University, Prague II. Trojanova 13; and Dr. J. Heyrovsky, Professor of Physical Chemistry, Charles University, Prague II., Albertov 2030.

CHEMISTRY.

By An Ignorant Student.

If in Botany and Zoology the Cell works on a chemical principle, so also does the Electric Cell.

There must, therefore, be considerable similarity between the working of the biological Cell and the Electric Cell.

We may say that the Cell of "life" of living pulsating matter—is electric in its working.

But what is the principle of the Electric Cell?

What was Galvani's discovery (1793) which has been adapted, altered, varied by others since?

Is is that an acid or stimulant excites a *reaction* in a material substance, and so causes current to flow—causes the Electrons to be "jostled" and active, and to escape from their imprisonment in the Atom? Is that it?

Do we not see in chemical action many of the same principles at work that are to be discerned elsewhere? (*e.g.*, the Dynamo).

But Chemistry is of course a late development. It is *inter-action* and *therefore* secondary.

Is it not the result of combination and of grouping?

Chemistry is *combination*—mostly, if not always, with resulting activity and reaction.

The Chemical Elements are Compounds—even the simplest of them.

Such compounds may not improperly be described *as three-dimensional*.

But the combination to have these effects, must be of unalikes rather than of alikes. The dissimilarity must be in Numbers, or Volume, or Density, or Function.

Singles may combine with doubles, but perhaps never with singles—for units are negatives and halves, simple units are, even if they be "doubles," and they do not combine with each other, at any rate *readily*, as we know from what we know or think we know of the Aether.

At anyrate halves of the same sort do not combine with each other in a chemical sense, so as to have reactions or produce something different.

Atoms of Hydrogen make its volume (Numbers). They do not change the nature of the substance—they do not combine with each other.

Combination is a feature rather of the 2nd and 3rd Dimensions. It is axiomatic that in the Second Dimension there must be at least two, and the same applies to combination.

There must be two for combination and those two must be dissimilar in some one or more respects.

SIR ARTHUR KEITH COMPARES THE BRAIN TO A NEWSPAPER.

On January 18 Sir Arthur Keith lecturing before the Royal College of Surgeons, London, said that at the beginning of the present century anatomists set out in earnest to make an elaborate survey of the grey rind or cortex of man's brain; the first maps produced were comparatively simple, but had since become more complex, the latest showing the cortex of the brain divided into over 100 distinct districts or areas.

In later maps, although there was complete agreement as to the main areas, there was still a considerable discrepancy as regards the number and extent of the secondary or minor areas. This could be understood when it was remembered that a geographer might may the same country in many different ways; he might divide it according to density of population, type of industry, or nature of the soil, the same circumstances applied to mapping the brain. *The geographer of the brain was guided in* the main by the arrangement, form, size, and branching of the living microscopic units or neurons which made up the cortex.

The most striking generalisation which had emerged from recent research on the brain was to show that all the cortex behind the central fissure had to deal with the receipt and manipulation of messages streaming from the sense organs of the body and all that lay in front was executive or controlling in function. General opinion, which had long favoured an ample forehead as a mask of ability, was receiving some degree of justification from modern inquiry.

There was a degree of resemblance between the organisation of a newspaper office and that of the brain. Messages from various quarters flowed in and, according to their nature, passed to departments devoted to foreign news, politics, commerce, sport, fashion, etc. Between the time messages were received and the time they passed to "*expression*" in the hands of the printer, much staff work had to be done. The news might be old, or libellous, or uninteresting; it had to be examined, formulated, and arranged; some part of the staff must think of the policy of the journal and make provision for future issues. The organisation in the human brain was apparently of a similar kind. The remarkable thing in the course of evolution of the animal brain was that it was not the staffs which handled the messages and which saw to the printing of the news that had increased; the changes

which had come about concerned the "editorial staff." It had kept on growing *until in the human brain it had become* enormous. In the lowest mammals the cortex of the brain was made up almost entirely *of the staffs which handled the* messages and the men who ran the printing *machines. As the brain was followed upwards in its course of evolution these primary* groups became pushed aside and separated more and more by "staff" cortex *until in the brain of man the* "staff" areas completely overshadowed the original members.

ARCHITECTS AND BUILDING CORROSION BY SMOKE AND AIR POLLUTION.

Mr. Arnold Marsh, secretary of the Smoke Abatement League of Great Britain, addressing a conference of architects in Manchester on January 22, said that with the possible exception of the medical profession the smoke problem probably concerned architects more than any other corporate body of people. The effect of smoke upon buildings was most serious, especially in industrial and congested areas. Not only did smoke attack buildings in the cities, but its effects were widespread, owing to the ease with which it could be disseminated over large areas. Thus they found corrosion well marked in Hampton Court Palace, Tintern Abbey ,and Windsor Castle.

The acid-laden air had also a deleterious effect upon the interior decorations and works of art which were often housed in historic buildings. While the destruction of modern buildings was serious enough it was hard to find words adequate to express the feeelings raised by the wanton manner in which irreplaceable treasures were being allowed slowly to rot away through the never-ceasing smoke corrosion.

The most serious effect of all was upon health. The death-rate from respiratory diseases often directly attributable to smoke was generally sharply increased after a period of smoke fog.

WHOLESALE PRICES IN 1928.

For the past year the aevrage of wholesale prices, at 84.4, shows a reduction of nearly one per cent., from 1927, the figure for which was 85.2. For the month of December the index number is 83.2, against 83.0 in the previous month and 84.5 in December, 1927.

Proceedings and Notices of Societies

THE OPTICAL SOCIETY.

At the meeting of the Optical Society held at the Imperial College of Science and Technology, South Kensington, on Thursday, January 17, the following papers were read and discussed :—

The Function of the Lens Capsule in the Accommodation of the Eye. By E. F. FINCHAM, Northampton Polytechnic Institute, London.

Although abundant evidence is now available in support of the general principle of Helmholtz's theory of accommodation, no definite explanation has been given of the formation of the "lenticonus" discovered by Tscherning, which led him to challenge that theory. In a paper in 1925 the author suggested that the varying thickness of the capsule covering the anterior surface of the lens would account for the type of surface which Tscherning had described.

The present paper describes the determination of the form of the anterior surfaces of the lenses of freshly dead animals, by making photographic records of the image reflected from the surface. The lenses of a number of different species were examined and records made when the lens was held under tension by its normal suspensions and also when the suspensions were removed. The thickness of the capsule in each case was then measured microscopically.

The results show that in primates the anterior surface of the lens assumes a somewhat conical form with an area of increased curvature in the centre, when the suspensions are severed. The capsule of the primate lens has a zone of increased thickness surrounding a central thin area.

Photographs of the profile view of a monkey's lens, which was removed from the eye and suspended in oil, showed it to be in the typical accommodated form. A similar view of the lens without its capsule showed a close approach to the unaccommodated form.

The anterior lens capsule of animals of an order lower than the primates was found to be approximaltely uniform in thickness. The lenticonus is not found in these cases, and the removal of the capsule does not cause an appreciable change in the form of the lens.

From these findings the theory is formulated that accommodation consists of a relaxation of tension upon the lens by the contraction of the ciliary muscle as stated by Helmholtz. This relaxation allows the capsule to press upon the lens substance and mould it into the accommodated form. In the unaccommodated state the tension under which the lens is held by its supporting fibres does not permit this compression. The unaccommodated lens substance is therefore in its unrestricted or natural form and not under compression as supposed in the Helmholtz theory.

A Double Reflexion Level. By D. S. PERFECT, M.A., D.Phil.

The level described in this paper was designed to assist the initial levelling of a floating system and to enable observations to be made on the constancy of level over extended periods of time. Its error may be determined by direct measurement and without reversal. The level in any direction is shown. The device has proved quite convenient in use and may possibly be found suitable for other purposes.

Photographs of Reflection Caustics. By T. SMITH, M.A., F.Inst.P., JOHN S. ANDERSON, M.A., D.Sc., F.Inst.P., AND L. C. CORDLE.

This paper describes a series of remarkably interesting and beautiful photographs of the caustics formed by reflection at the surfaces of a photographic lens of large aperture. The photographs were exhibited and Dr. Anderson demonstrated the formation of the caustics to members of the audience.

Votes of thanks were awarded to the Authors of the papers and carried with acclamation.

MINERALOGICAL SOCIETY.

The following papers were read at the meeting held on January 15, Dr. G. T. Prior, F.R.S., President, in the Chair :—

The Tholeiite Dikes of the North of England. By PROF. A. HOLMES AND DR. H. F. HARWOOD.

The suite of tholeitte dikes in the North of England, bounded on the north by the Acklington dike and on the south by the Cleveland dike, form an outlying part of the Mull Swarm. To the Salen, Brunton and Talaidh types already recognised in Mull the authors add Cleveland and Acklington types, and anorthite-bearing varieties of each. Chemical and mineral analyses are presented, and from a comparative study of the evidence it is shown that there are many features in the series as a whole which are not in accordance with the theory of crystallisation-differentiation.

On the Occurrence of Gold at Hope's Nose, Torquay, Devonshire. By A. RUSSELL.

A detailed description is given of a remarkable occurrence of crystallised arborescent gold in calcite, in Middle Devonian limestone at Hope's Nose, where it was discovered by Professor W. T. Gordon in 1922. Specimens, many of which are extremely beautiful, have since been obtained from five distinct veins. The gold varies in colour from a bright rich gold to almost silver-white, and has a silver content of only 1.89 to 8.41 per cent.

Crystallography of some Organic Compounds. By H. E. BUCKLEY.

Collected records of goniometric measurements on crystals of various organic compounds.

THE PHYSICAL SOCIETY.

The following papers were read on January 25 :—

A Fused Quartz Pendulum Rod for Clocks. By PROF. C. VERNON BOYS, F.R.S.

The author discusses the possible causes of the progressively increasing losing-rate found in the going of the Shortt clock. He shows a design for the free pendulum suitable for use where the rod is made of fused quartz. He would prefer carbon steel for the supporting springs and mild steel for the bob.

A Method for the Determination of the Equivalent Resistance of Air Condensers at High Frequencies. By G. W. SUTTON, B.Sc.

The losses in air-condensers are divided into two portions : (*a*) those due to leakage through the solid dielectric ,and (*b*) those due to terminal and plate resistance. A method is developed for measuring each, under conditions such that the other is negligibly small. The limits of the errors to which the methods are liable are discussed and some results of practical measurements are quoted.

The Measurement of the Anode Circuit Impedances and Mutual Conductances of Thermionic Valves. By L. HARTSHORN, A.R.C.S., B.Sc., D.I.C., The National Physical Laboratory.

The paper describes the application of the Wheatstone Bridge to the measurement of the anode circuit admittance or impedance, and the mutual conductance of a valve under actual operating conditions. Current of telephonic frequency is used. The measurements can be made for grid bias of any desired value, and both methods can be made direct-reading. The results of measurements made on a few typical valves were given, and it is shown that although both anode circuit resistance ,nd mutual couductance vary very considerably with the grid bias, the product of the two, which gives the voltage factor of the valve, is approximately constant. The anode circuit admittance consists of a conductance associated with a comparatively small capacity, but this capacity is larger than the interelectrode capacities of the valve when the filament is cold. The increase in the effective values of the inter-electrode capacities is explained by the presence of the space charge, which also has the effects of making these capacities vary with the frequency and of giving them a comparatively high power factor, especially at low frequencies.

INSTITUTE OF CHEMISTRY.

Irish Free State Section.

The annual general meeting was recently held in the Physics Lecture Theatre, Trinity College, Dublin, Professor W. E. Adeney presiding.

The reports of the honorary secretary and treasurer having been received and adopted the chairman declared the committee re-elected as follows : Professor W. E. Adeney, Dr. J. Bell, Mr. B. G. Fagan, Dr. A. G. G. Leonard, Dr. J. H. Millar, Mr. A. O'Farrelly, Mr. J. W. Parkes and Professor S. Young. Messrs. G. Brownlee and P. O'Callaghan were re-elected honorary auditors.

Mr. A. C. Brookes delivered an address describing the nature of the work carried on at the Government Laboratory in Singapore. He said that the work was large in volume and varied in nature. Speaking of the testing of fuel oils, he referred to the inconsistency of the results obtained in the viscosity test at 32° F., while the results obtained at 40° F. were quite consistent. He felt that little value could be attached to those obtained at the lower temperature.

A large proportion of the population of the Straits Settlements consists of Chinese of whom the well-to-do smoke a prepared form of opium known as chandoo. Chandoo, once smoked, leave a residue known as dross, which was smoked by the poorer Chinese with harmful results. The government have endeavoured to stop dross smoking by offering a relatively high price for dross. Thus, chandoo costs about 12 dollars (28s.) per tael (1.3 oz.) and contains about 10 per cent. morphine, while a good once-smoked dross should contain more than 4 per cent. morphine, and is paid for by the government at seven dollars per tael. Sophistication of the dross led to the necessity of analytical control for all dross returned, and some 400 tests are carried out weekly. All dross purchased in this manner is subsequently destroyed by the government.

Of alcoholic liquors the commonest are brandy and toddy, the latter being the juice of a local palm, which ferments spontaneously and rapidly. Toddy more than two days old is definitely harmful, and vendors are not permitted to have such on their premises. Acidity calculated as free acetic acid is a measure of the age of toddy, and must not exceed 0.8 gr. per 100 c.c. Sophistication by adding water, and sometimes also raw spirit, necessitates other determinations.

Cow's milk is consumed to some extent, and when adulterated by adding water and buffalo milk (6 per cent. fat) the adulteration is difficult to detect, unless overdone.

Speaking of the liquefaction test on explosives, he said that few, if any, samples passed the test, which was probably due, in his opinion, to the high humidity of the climate in Singapore.

Tin concentrates were assayed by a method which required 90 minutes, each stage being carefully timed. The sample, finely ground and dried, was fused with soda, extracted with hydrochloric acid, reduced by nickel, after the addition of marble, titrated with iodine in an atmosphere of carbon dioxide.

Many other types of analysis were briefly mentioned by Mr. Brookes, who also exhibited a number of slides illustrating the nature of the country in the vicinity of Singapore.

The Chairman conveyed the hearty thanks of the meeting to Mr. Brookes, and spoke of the pleasure which the members felt in having him in Dublin again.

—*Journal of the Institute of Chemistry.*

NOTICES OF BOOKS.

The Collected Scientific Papers of John James Waterston. By J. S. HALDANE, M.D., LL.D., F.R.S. Pp. lxviii + 709. Oliver and Boyd, Edinburgh: Tweedale Court; London: 33, Paternoster Row, E.C. 25s. net. 1928.

Mr. J. J. Waterston was born in Edinburgh in 1811 and died there in 1883, having wandered from his lodgings, and it is believed accidentally fell into the sea. Waterston came to London at the age of 21 in pursuit of civil engineering, which he afterwards practically abandoned for pure science and the teaching of navigation, gunnery, etc. He took up temporary residence with his grand-uncle—Mr. George Sandeman — at St. Swithin's Lane. In a letter bearing this address young Waterston wrote:—" I heard Mr. ——'s third sermon. I cannot give you any very flattering account of his qualifications. He is by no means eloquent, but as his head is a perfect Cruden's *Concordance* he is very clever at the parallel passages. Michel and Robert Faraday were made deacons the other week. I spent an evening with Henry Bell, who gave the most extraordinary accounts of the former gentleman. If all is true, I shall certainly revere him, not only as the first chemical philosopher in the world, but, likewise, as one who is quite unmoved by all the honours that have been heaped upon him."

At the age of 10 Waterston published a paper in the *Philosophical Magazine* (p. 531 of this book) on gravity. This remarkable statement appears:— " A medium is supposed to envelop the universe, every particle of which is a minute reservoir of power, which is conserved in the rectlineal and rotary motion with which it is endowed. These motions, by the introduction of the gross particles of different substances, are alternately transformed into each other; and thus the primordial power of Œrsted's doctrine by the varied structure of the particles of matter ' operates in different forms of action ' and is everywhere developed in the diversified series of natural changes." The purport of this paper is a mechanical basis for gravitation.

The tragedy of Waterston's scientific career was the refusal of the Royal Society to publish his important contribution: *The dynamical theory of gases and of heat and temperature.* It was the late Lord Rayleigh who discovered this paper (see title below) in the archives of the Royal Society, and brought it to light by publication with notes. This stimulated interest. Haldane, therefore, now gives a long memoir of Waterston and then follows his scientific papers proper which are reproduced in full in this single volume, the titles being:—Thoughts on the Mental Functions, 1843; Notes on Molecularity, 1843; Note on the Physical Constitution of Gaseous Fluids and a Theory of Heat, 1843; Physics of Media that are composed of Free and perfectly Elastic Molecules in a State of Motion (with the late Lord Rayleigh's Introduction and Notes, and an abstract of a paper on A General Theory of Gases, submitted to the British Association in 1851), Submitted to the Royal Society, 1845, Published 1892; Account of a Mathematical Theory of Gases, 1845; Deviation from the Primary Laws of Elastic Fluids, 1857; Theory of Sound, 1858; A General Law of Density in Saturated Vapours; Capillarity and its relation to Latent Heat, 1858; Evidence of a Gradual Difference between the Thermometers of Air and Mercury, 1858; Law of Liquid Expansion, 1861; Expansion of Water at High Temperature, 1863; Liquid Expansion, 1864; Certain Thermolecular Relations of Liquids and their Saturated Vapours, 1868; New Dynamico-Chemical Principle, 1831; Integral of Gravitation, and its Consequents with regard to the Measure and Transfer, or Communication of Force, 1858; Chemical Notation in conformity with the Dynamical Theory of Heat and Gases, 1863; Chemical Notation, 1863; Application of the Vapour-Density System of Notation to express Chemical Reactions, 1864; Electrical Experiments and Induction, 1865; Electrical Experiments, 1865; Thermal Action in the Wire of a Voltaic Circuit; Electric Conduction, 1865; Finding the Latitude, Time, and Azimuth, 1842; Graphical Method of produsing Occultations, 1844; Remarks on the Comet, 1845; Direct Method of determining the Distance of a Comet by three Observations, 1845; Graphical Method of computing the Eccentric Anomaly, 1850; Thoughts on the Formation of the Tail of a Comet, 1859; Observations on Solar Radiation, 1861; Change that would take place in the Elements of the Earth's Orbit by a Sudden Accession to the Sun's Mass, 1866; Change that would be induced in an Elliptic Orbit if the Intensity of the Force of Gravity were influenced by the Centripetal Velocity of the Orbital Body, 1867; Heat of the Stars, 1878; Solar Thermometer Couple to measure the Heat of Daylight, 1878.

Waterston regarded the problems of life

as bound up in the behaviour of molecules and in a general way suggested the basis of biophysics, but he was aware of limitations as biophysics is quite a "different world from that of ordinary physics and chemistry"—as we know to-day.

The great anticipatory advance Waterston made in 1845 was in showing that ideally perfect gases can be treated without introducing such concepts as *imponderability* and *action at a distance*.

It is sad to relate that within the 15 years dating from the rejection of Waterston's paper presented to the Royal Society his dynamical explanation of the gas laws had been "independently discovered piecemeal by Krönig, Clausius, and Clerk Maxwell, the rediscovery beginning with a paper by Krönig in 1856; and long before the end of last century the kinetic theory of gases and a dynamical conception of heat and temperature had become a commonplace in ordinary text-books." The reader is referred to J. S. Haldane's GASES AND LIQUIDS, 1928 (published by the same publishers of this book under review), for a more complete account of this subject with special regard to Waterston's contributions. It should form a companion volume to this one. It contains a new interpretation of van der Waal's equation and new light is thrown on the transition state of gases—gaseous to liquid—and also critical temperatures. "A further interpretation of the properties of liquids is largely based on Waterston's investigations."

The importance of these collected papers will thus be seen.

Waterston's style is exceedingly elegant as may be judged from the follolwing words taken from page 535. "These views of the transference of motion are further deserving of attention by their accordance with the simplicity of nature, and by tending to clear science of all those auxiliary causes, the introduction of which, though necessary to explain the contrary hypothesis, has yet proved a serious obstacle to the progress of true philosophy. If founded on truth, they induce a lively hope that matter and motion alone will be found sufficient to explain all the phenomena attending the grand cycle of nature's operations, and that that system of unity and simplicity which the advancement of discovery is always bringing further into view will at length be completely unfolded, and all the physical sciences eventually traced to the varied development of these two principles."

There are several fine plate illustrations, and the book would form a valuable addition to a library from the purely artistic point of view, but the book is obviously one of science as well.

Dr. Haldane has done science a rare service in publishing the life work of Waterston who was endowed with a remarkable truth-probing instinct, the hall-mark of a great man.

F. H. L.

A Class Book of Physical Chemistry. By T. MARTIN LOWRY, C.B.E., M.A., D.Sc., F.R.S., AND SAMUEL SUGDEN, D.Sc., A.R.C.Sc.(Lond.), A.I.C., Reader in Chemistry, Birkbeck College, University of London. Pp. 436. Price 6s. 6d. London: Macmillan & Co., Ltd.

This is a very useful student's hand book. The instructions are concise, with assistant illustrations, and the formulæ clearly set out. There are fifteen chapters, commencing with the Gaseous State and ending with Adsorption. Each chapter is immediately followed by a series of questions, while a number of answers are given towards the end of the work and will be found time-saving and otherwise helpful. The Book is well printed on good paper, and bound in cloth, stiff covers.

ECONOMIC CONDITIONS IN MOROCCO.

British Consular Officers report upon the Tangier and the Spanish Zone of Morocco. Both areas are passing through difficulties, ascribed largely to the withdrawal of Spanish troops from the latter Zone, but considerable progress is being made with port improvements and other public works which should ultimately benefit trade.

Forthcoming Events.

ROYAL INSTITUTION.

Friday, February 1, at 9 p.m.—Prof. J. L. Myres: "Geometrical Art."

Satnrday, February 2, at 3 p.m.—Mr. E. Cammaerts: "Flemish and Belgian Art—Genre Painting."

Monday, February 4, at 5.15 p.m.—General Meeting.

Wednesday, February 6, at 5.15 p.m.—Prof. J. S. Huxley: "Evolution and the Problem of Species."

Thursday, February 7, at 5.15 p.m.—Sir William Bragg: "The Early History of X-rays."

Friday, February 8, at 9 p.m.—Mr. C. E. R. Sherrington: "Recent Problems of Rail Transport at Home and Abroad."

Saturday, February 9, at 3 p.m.—Dr. S. Marchant: "Music in Cathedral and Collegiate Churches."

ROYAL SOCIETY OF ARTS.

Monday, February 4, at 8 p.m.—(Cantor Lecture. C. H. Lander, C.B.E., D.Sc., M.Inst.C.E.,F.Inst.P., Director of Fuel Research, Department of Scientific and Industrial Research: "The Treatment of Coal." (Lecture III.) Low Temperature Carbonisation. Liquefaction of coal. Low temperature carbonisation. Internal and external heating. Hydrogenation processes. Synthetic processes. Combustion of oil.

Wednesday, February 6, at 8 p.m.—(Trueman Wood Lecture.) Sir J. Alfred Ewing, K.C.B., M.A., LL.D., D.Sc., F.R.S., M.Inst.C.E.: "The Vibrations of Railway Bridges: An Example of Co-operative Research."

Friday, February 8, at 4.30 p.m.—(Indian Meeting). Captain E. J. Headlam, C.S.I., C.M.G., D.S.O., R.I.M.: "The History of the Indian Marine."

Wednesday, February 13, at 8 p.m.—(Ordinary Meeting.) Cecil Hooper, F.L.S.: "The Pollination of Fruit Blossoms and their Insect Visitors."

Monday, February 18, at 8 p.m.—(Shaw Lecture.) Sir Thomas M. Legge, C.B.E., M.D., Senior Medical Inspector of Factories, 1898-1927: "Thirty Years' Experience of Industrial Maladies." (Lecture I.)

Wednesday, February 20, at 8 p.m.—(Ordinary Meeting.) Major T. H. Bishop M.R.C.S., L.R.C.P., D.P.H.: "The Purification of Water."

Monday, February 25, at 8 p.m.—(Shaw Lecture.) Sir Thomas M. Legge, C.B.E., M.D., Senior Medical Inspector of Factories, 1898-1927: "Thirty Years' Experience of Industrial Maladies." (Lecture II.)

Wendesday, February, 27, at 8 p.m.—(Ordinary Meeting.) A. F. Suter: "Resins."

SOCIETY OF PUBLIC ANALYSTS.

The next meeting of the Society will be held on Wednesday, February 6, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1., at 8 p.m. The following papers will be read:—

"The Fatty Acids and Component Glycerides of Some New Zealand Butters." By T. P. Hilditch, D.Sc., F.I.C., and Eveline E. Jones, M.Sc.

"A New Test for Boric Acid and Borates." By A. Scott Dodd, B.Sc., F.I.C., F.R.S.E.

"The Determination of Beryllium in Rocks." By B. E. Dixon, M.Sc., A.I.C.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

1,060.—Bogandy, S. von., and Polanyi, M.—Production of chemical compounds. January 11th.

1,056.—Borchers, R.—Production of sulphuric acid. January 11th.

577.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of benzene, etc. January 7th.

1,086.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of hydroxy carboxylic acids of carbozole. January 11th.

Specifications Published.

303,389.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.). — Manufacture of carboxylic acids of the fatty-aromatic series.

303,432.—Ruzicka, C.—Production of cellulose acetate and mixed cellulose esters containing acetyl and other carboxylic radicles.

303,468.—Carpmael, A. — Manufacture of white titanic acid.

303,469.—Carpmael, A. — Manufacture of cyanogen chloride.

294,602.—Soc. Anon. M. Naef et Cie.—Preparation of the lactone of 14-oxy-tetradecane-1-carboxyl acid.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

300,903.—Alkali ammonium phosphates.—Stockholms Superfosfat Fabriks Aktiebolag, 4, Kornhamnstorg, Stockholm.

In the treatment of the reaction product of phosphatic materials and acid or acid mixtures with alkali sulphates to remove calcium as gypsum and of the resulting solution of alkali salts with excess of ammonia with precipitation of the resultant products, the solution is cooled during the treatment with ammonia, say to 0° C., if desired under pressure, whereby precipitation is substantially complete and the mother liquor for re-use consists almost solely of ammonia.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

VIGESTA.

495,595.—Chemical substances prepared for used in medicine and pharmacy.—J. Bury, Limited, 5, St. Ann Street, Manchester. January 16th

EUFLOTOL.

497,093.—Chemical substances used in manufactures, photography or philosophical research and anti-corrosives.—I. G. Farbenindustrie Aktiengesellschaft, 28, Mainzer Landstrasse, Frankfurt-on-Main, Germany. January 16th.

ARCADIAN.

494,911.—All goods in class 1 which includes chemical substances used in manufactures, photography, philosophical research, and anti-corrosives.—The Barrett Company, 40, Rector Street, City and State of New York, United States of America. January 16th.

WANTED, *Chemical News* issue for January 6th, 1928, clean for binding.—Reply to *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

" EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News*. Price 5s.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager, The Chemical News, *Offices* : Merton House, Salisbury Square. London, E.C.4.

THE CHEMICAL NEWS AND JOURNAL OF INDUSTRIAL SCIENCE.

Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, *post free*, for a year, for 30s.

Offices : Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant for acids.

Sole Makers: THE WATPROOF CO., 18, Rue de Bretagne ASNIERES (Seine) FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3591.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

The Absolute Zero of Temperature—Addendum ... 81
By F. H. Loring.
The Collinsics of Minerals. IX. ... 82
By Hawksworth Collins, B.A.
Einstein's New Ideas ... 83
By F. H. Loring.
Smokeless Fuel Shortage ... 84
General Notes ... 85
Proceedings & Notices of Societies:—
The Royal Society ... 88
The Institute of Chemistry ... 90
Geological Society ... 91
The Chemical Society of Japan ... 92
Royal Society of Arts ... 93
Notices of Books ... 93
Forthcoming Events ... 94
New Patents ... 95
New Trade Marks ... 96

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

INDEX TO VOL. 137 IS INCLUDED THIS WEEK.

THE ABSOLUTE ZERO OF TEMPERATURE; THE SPECIFIC HEATS OF GASES; AND DEDUCTIONS RESPECTING QUANTA.—*ADDENDUM.*

By F. H. LORING.

In my previous article titled as above, in this Journal (1929, 138, 18), particular attention was drawn to the value of Avogadro's number (N). It is of interest in this connection to take note of any recent contributions. In the *Physical Review* (1928, 32, 841) A. P. R. Wadlund has a paper on "Absolute X-Ray Wave-Length Measurements," which concludes with the evaluation of N and e, the equation for N being—

$$N = nM/\rho d^3\phi(\beta),$$

where n represents the number of molecules in each elementary rhombohedron; M the molecular weight of calcite ($CaCO_3$); d the crystal grating space of calcite (=3.0290A); ρ its density; and $\phi(\beta)$ the volume of the rhombohedron, the distance between the opposite faces of which is unity, and the angle between the edges, β, is that between the axes of the crystal. The value of N so calculated is 6.061×10^{23} according to the above author, and this agrees with the value I have used in preference, but it should be noted that there is some possible error which Wadlund gives as $\pm$ 0.009, affecting the left-hand value above. Attention has been drawn to a paper by E. Bäcklin (Inaugural dissertation, *Upsala Universitets Arsskrift*, 1928) in which the g.s. value for calcite is found to be 3.033 $\pm$ 0.003A.

Reference was made before to a previous article of mine on the photo-electric effect. See also in this connection "A Note on Radiation," *Chemical News*, Nov. 4, 1927, vol. 135, p. 296.

There is a slight decimal place error in my value given at the bottom of page 18. It should read 1.6558. On page 21, 25th line up in left-hand column, "the" should read: its.

THE COLLINSICS OF MINERALS. IX.

By Hawksworth Collins, B.A. (Camb.).

Explanations of the figures found and employed below have frequently been given in the *Chemical News*, but especially in the last paper (December 28).

The thick type denotes the discovery, whilst the ordinary type gives the figures (of other scientists) which were employed to make the discovery.

The *only new element introduced* is phosphorus, of which the relative volume is 14.56 and optical refractivity 10.51.

Table XII.

The Collinsics of Twelve Minerals.

No.	Mineral and Collinsics	Theor. Column	Obs. Column	
(97)	Clinoclasite $Cu_3(OH)_3AsO_4$			
	$Cu_3 + H_3 + As + O + O_3 + O_3$	**4.373**	4.36 - 4.38	D
	$76.183 = 0.8791(7.13_3 + 5.76_3 + 19.58 + 7.53 + 4.45_3 + 2.51_3)$	**1.8791**	N_m 1.870	W
			N_g 1.91	W
	$76.182 = 13.22_3 + 2.613_3 + 17.75 + 1.654 + 1.747_3 + 1.346_3$			
(98)	Cornwallite $Cu_5 + As_2 + O_4 + O_6 + 3H_2O$	**4.19**	4.17	D
	$136.001 = 0.8391(7.13_5 + 19.58_2 + 7.53_4 + 2.51_6 + 14.03_3)$	**1.8391**	N_m 1.815	W
			N_g 1.85	W
	$136.008 = 13.22_5 + 17.75_2 + 1.654_4 + 1.346_6 + 6.572_3$			
(99)	Newberyite $H + Mg + P + O_2 + O_2 + 3H_2O$	**2.08**	2.1	D
	$44.058 = 0.5255(5.76 + 7.51 + 14.56 + 4.45_2 + 2.51_2 + 14.03_3)$	**1.5255**	1.5196	D
			1.533	S
	$44.056 = 2.613 + 5.031 + 10.51 + 1.747_2 + 1.346_2 + 6.572_3$			
(100)	Fluorapatite $Ca_5 + F + P_3 + O_3 + O_9$	**3.195**	3.188 - 3.199	D
	$101.742 = 0.645(14.54_5 + 5.42 + 14.56_3 + 4.45_3 + 2.51_9)$	**1.645**	1.64607	D
			1.64172	D
	$101.745 = 10.52_5 + 0.26 + 10.51_3 + 1.747_3 + 1.346_9$			
(101)	Herderite $Ca + F + Be + P + O + O + O_2$	**2.972**	2.99	D
	$33.842 = 0.617(13.25 + 5.42 + 4.62 + 14.56 + 7.53 + 4.45 + 2.51_2$	**1.617**	1.612 - 1.621	D
	$33.846 = 13.25 + 0.26 + 3.733 + 10.51 + 1.654 + 1.747 + 1.346_2$			
(102)	Beryllonite $Na + Be + P + O_2 + O_2$	**2.8244**	2.845	D
	$24.294 = 0.5403(11.865 + 4.62 + 14.56 + 4.45_2 + 2.51_2)$	**1.5403**	1.552	D
	$24.294 = 3.865 + 3.733 + 10.51 + 1.747_2 + 1.346_2$			
(103)	Brushite $H + Ca + P + O + O_3 + 2H_2O$	**2.205**	2.208	D
	$42.476 = 0.5447(5.76 + 14.54 + 14.56 + 7.53 + 2.51_3 + 14.03_2)$	**1.5447**	N_m 1.5455	W
			N_p 1.5392	W
	$42.479 = 2.613 + 10.52 + 10.51 + 1.654 + 1.346_3 + 6.572_2$			

	Theor. Column	Obs. Column	
(104) Martinite $H_2 + Ca_5 + P_4 + O_3 + O_{13} + \frac{1}{2}H_2O$			
	2.89	2.89	W
$125.613 = 0.6137(5.76_2 + 14.54_5 + 14.56_4 + 7.53_3 + 2.51_{13} + 14.03_{0.5})$			
	1.6137	1.606 N_m	W
$125.612 = 2.613_2 + 10.52_5 + 10.51_4 + 1.654_3 + 1.346_{13} + 6.572_{0.5}$			
(105) Spodiosite $Ca_2 + F + P + O + O_2 + O$			
	2.965	2.94	D
$43.766 = 0.669(13.25_2 + 5.42 + 14.56 + 7.53 + 4.45_2 + 2.51)$			
	1.669	N_m 1.674	W
		N_p 1.663	W
$43.764 = 13.25_2 + 0.26 + 10.51 + 1.654 + 1.747_2 + 1.346$			
(106) Tagilite $Cu_2(OH)PO_4.H_2O$			
$Cu_2 + H + P + O + O_4 + H_2O$			
	4.06	4.076	Brei
$53.269 = 0.8442(7.13_2 + 5.76 + 14.56 + 4.45 + 2.51_4 + 14.03)$			
	1.8442	N_m 1.84	W
		N_g 1.85	W
$53.266 = 13.22_2 + 2.613 + 10.51 + 1.747 + 1.346_4 + 6.572$			
(107) Variscite $Al + P + O + O_3 + 2H_2O$			
	2.482	2.408	D
		2.54	W
$37.305 = 0.5861(9.05 + 14.56 + 4.45 + 2.51_3 + 14.03_2)$			
	1.5861	1.579–1.589	W
$37.304 = 7.865 + 10.51 + 1.747 + 1.346_3 + 6.572_2$			
(108) Vashegyite $Al_8 + P_6 + O_6 + O_{21} + 30H_2O$			
	1.956	1.96	W
$337.315 = 0.48013(12.05_8 + 14.56_6 + 7.53_6 + 2.51_{21} + 14.03_{30})$			
	1.48013	1.48	W
$337.314 = 4.863_8 + 10.51_6 + 1.654_6 + 1.346_{21} + 6.572_{30}$			

EINSTEIN'S NEW IDEAS.

One can write a preface without knowing much about the subject matter of a book, so long as the foreword is made a stepping stone to that which follows. I will therefore write a few lines leading up to Einstein's new development as I partly understand it.

Clerk Maxwell's equations of the magnetic circuit were regarded for a long time as satisfactory, but these, that is to say, the field equations, do present difficulties in view of the present relativity theory.

Maxwell's mathematical treatment did secure the correct answers as applied to electromagnetic phenomena, and this in itself was a great accomplishment; but no doubt some students felt that somehow the mathematical part was not in accord with the behaviour of lines of force as depicted by the pictorial school.

Wise men said that the attempt to make a theory simulate common ideas and so give it a modelistic or pictorial aspect was dangerous, as it might lead to erroneous conceptions hardly in agreement with experience as expressed by the mathematical school. This attitude of mind seems to have extended of late, so that all more or less ultimate analyses of phenomena must be purely mathematical.

This is certainly a debatable point, as mathematical constructions are liable to error. For example, Einstein in his new development appears now to be abandoning the Hamiltonian principle.

It can, however, be said with good reason, that sound mathematical theory is a powerful tool in giving the answer required in a particular case, whilst pointing the way to new fields of exploration. The modelists can also claim victories won by particularly

happy models. They were careful to avoid interpreting theoretically the characteristics to a full extent, however.

What to-day is the correct attitude of mind in these matters may not be the correct attitude years hence.

It is difficult to put pen to paper and write anything that will stand the test of moderate time. On the other hand, the converse attitude is *not* constructive. The whole scheme of science to-day seems to be one of a constructive policy in which the factors are labelled as near to the truth as present knowledge allows. The figures speak for themselves as figures and beyond this there is danger, yet in other respects the older plan of associating figures with definite pictorial ideas has much in its favour if used with a constant lookout for some flaw in the detail.

Experiment is constantly correcting the errors of our ways, and I sometimes think if more pains were taken to describe the experimental behaviour so that one got very familiar with phenomena, that would be better than expounding elaborate theories, but there are gifted mathematicions who master the experimental side and become conversant with the working of the phenomena, so to speak. It is from such men we do expect theoretical ideas expressed more or less mathematically as their aim is to co-ordinate phenomena. Einstein is the greatest of these now living and he has just given us a new product from his brain that has been announced with great *éclat* in the daily Press.

It seems that to bring *Gravitation* and *Electricity*, that is to say the grosser phenomena of these two great phases of science, into correlationship, Einstein has proposed a new geometry which is neither strictly Riemannian nor strictly Euclidean, but is, perhaps, a cross of the two. In this geometry the parallelism ("far-parallelism") of the world lines may be said to be in conformity with Euclid and as a result new basic definiteness is obtained. Einstein's new ideas promise to give information concerning the connection or interaction of gravity and magnetism, which up to the present time have appeared as quite independent phenomena, except in so far that light (an electro-magnetic disturbance) is affected by the gravitational field, as instanced by the bending of light from distant stars when passing close to the sun: Einstein's well-known prediction that was experimentally proved.

F. H. L.

SMOKELESS FUEL SHORTAGE.

Nine Members of Parliament were among the large number of guests who visited Coalite House, Grosvenor Place, London, the new headquarters of Low Temperature Carbonisation, Ltd., on Thursday, January 24, for a demonstration of the progress made in the low temperature carbonisation of coal during the past eighteen months.

The Members were: Sir John Sandeman Allen, M.P. for the West Derby Division of Liverpool; Sir William A. Wayland, M.P. for Canterbury; Mr. T. Williams, M.P. for Don Valley; Miss Ellen Wilkinson, M.P. for Middlesbrough; Mr. D. R. Grenfell, M.P. for Gower; Mr. G. Barker, M.P. for Abertillery; Mr. Will Thorne, M.P. for Plaistow; Mr. G. H. Hall, M.P. for Aberdare; and Mr. W. Paling, M.P. for Doncaster.

The gathering took the form of a "house-warming," the guests being welcomed by Lieut.-Col. W. A. Bristow, Managing Director of Low Temperature Carbonisation, Ltd., with whom were Sir Arthur Wheeler (Chairman of the Company), and Mr. R. P. Wilson (Director).

Col. Bristow, in a short speech, made the striking observation that if the whole of the coal consumed in this country for domestic purposes were subjected to the low temperature process, there would be rendered available about 350 million gallons of petrol a year. He added that each week from the Low Temperature Works at Barugh, Yorkshire, there were dispatched about 30,000 gallons of crude oil and 5,000 gallons of petrol, in addition to some 1,200 tons of smokeless fuel.

Consumers near the works were able to buy coalite at under 30s. per ton, and the general price to merchants was about 27s. to 28s. per ton. Women who had once used the fuel were very disinclined to revert to the use of coal. For a long time past, however, the Company had been obliged to refuse all new customers and to-day they were 1,700 trucks in arrear with urgent orders.

Col. Bristow mentioned that the Company had received two deputations from Sweden, asking for supplies of smokeless fuel. Scandinavian interests had actually offered to take the whole of their output during 1929, and half-a-million tons for 1931.

The demonstration, he explained, had been organised not to increase the demand for smokeless fuel, but to bring before Members of Parliament and the general public the urgent necessity for developing low temperature carbonisation in this country.

"Many of the people who should be well acquainted with the subject of low temperature carbonisation," continued Col. Bristow, "are seriously ignorant in the matter. During the last 12 months, on no single occasion has it been stated by Ministers replying to questions in the House of Commons that there was a successful process at work in this country on a commercial scale.

"The decision of the South Metropolitan Gas Company, which has long been distinguished for the commercial and scientific attainments of its management, to turn over one of its London Works for the erection, at its own expense, of one of our plants, marks a stage in the progress of low temperature carbonisation of outstanding importance.

"But we are still confronted with a vast amount of ignorance and apathy. If women would now demand such action as would ensure a suitable speeding up in the matter of supplies, it would probably probably provide the greatest stimulus that the low temperature movement has ever received. I am not sure whether it would not be more important to women to have smokeless fuel than to have the vote, but both ideas would be satisfied if the latter were used to attain the former."

The guests afterwards inspected smokeless fires in various rooms, and there were many comments on the brightness and warmth of the fuel.

The Prague Credit Bank has just published (in French) a booklet giving a list of the Czechoslovak State Loans, municipal and regional loans for carrying out electrification and other public works, and certain company shares together with their market value in December last and the rates of interest and their yields per annum.

The Prague Credit Bank also controls a number of industrial concerns and the information given in the booklet is of interest to investors and others.

GENERAL NOTES.

THE BRAIN OF GENIUSES.

On January 21, Sir Arthur Keith lectured on the above subject. He said that the Government of Russia was spending as much on the examination of Lenin's brain as might have equipped a battleship, and it might not be a bad thing for the world if Governments employed more men in examining brains and fewer building ships of war. After all, the human brain was the sole organ concerned in the maintenance of civilisation. The aim of all such inquiries was to discover a means of estimating the capacities of the living brain, and thus making sure that village Hampdens, mute Miltons, Cromwells, and Lenins escaped the obscurity of country churchyards.

Although the anatomist's ideal was a complete examination of the brain, yet much could be learned by an examination of its external appearance. The brain of Charles Babbage, mathematician and inventor, which was preserved in the museum of the Royal College of Surgeons, was not only massive but was very highly developed in those parts which we had reason to regard as connected with certain particular forms of ability. Lately, Dr. Donaldson, of the Wistar Institute, Philadelphia, had given an account of the brain of the late Sir William Osler. The photographs of the brain showed that this distinguished scholar, physician, and writer was very highly endowed just in those regions which represent the later additions to man's brain.

Genius was usually associated with large brains, which showed special development of certain parts, yet there were many exceptions, the most remarkable being the case of Anatole France. The total weight of his brain was only 36oz.—12oz. short of the allowance given to a farm labourer—and yet it was a brain which thought, created, felt, and recorded in a way which astonished the world. Anatole France was in his 81st year when he died, and it was likely that his brain suffered in the decay which usually set in after 45, yet, if an allowance was made for this and for other circumstances, it was unlikely that even in its prime his brain reached the lowest stage of mediocrity so far as mere volume or mass was concerned.

DIATOMITE.

In view of the growing importance of diatomite, the Mines Branch of the Federal Department of Mines undertook to investigate thoroughly the available sources of supply in Canada, the methods of preparation, and the industrial uses of this material. The results of this work, which was carried out by V. L. Eardley-Wilmot, are published in a 180-page report entitled : " Diatomite : Its Occurrence, Preparation and Uses." (No. 691.) Price 30 cents.

Diatomite is a very light, white, powdery substance, composed of microscopically small siliceous shells, called diatoms, and is found in the bottoms of certain lakes or in solid beds having the appearance and hardness of chalk, sometimes hundreds of feet thick.

In the first chapter the author autlines the life history of the diatom, and the subsequent formation of diatomite. The uses of this material are enumerated and some of them are described in detail. The great porosity and lightness of this material makes it particularly well suited for use in filtration, insulation, absorbents, fillers, abrasives and structural materials. Particular attention has been given to its increasing use as an admixture in concrete, and the results of a series of tests on Canadian and imported material are given.

The second chapter is devoted to the methods of examining and sampling deposits and to the various tests that are necessary to determine the suitability of diatomite for its various uses.

Markets and prices are discussed in the third chapter, the imports and exports of the various countries all over the world being given, as well as the approximate quantity used in each of the different Canadian industries.

The fourth chapter describes in detail the Canadian diatomite deposits. All the known occurrences, of which there are about one hundred and twenty, are tabulated and in most instances a complete analysis is provided. Foreign deposits, particularly some of the larger ones in the United States, are also described. The table of world's production shows a steady rate of increase, but while that of Canada is at present comparatively small, the United States, which is the largest producer, now has an annual output of about 100,000 tons.

Mining methods, preparation for the market, and the manufacture of some of the various diatomite products, are described in the fifth chapter, which closes with some notes on the cleaning, and preparation of diatoms for mounting on slides. There is an extensive bibliography giving about 200 references.

Maps indicating the localities of all the known Canadian occurrences accompany the monograph, and numerous drawings and photographs depict the operations of some Canadian and United States producers. A series of photomicrographs illustrating the various characteristic diatoms in many of the deposits are well reproduced, particularly the frontispiece, in which the beautiful markings and scroll work characteristic of over 30 typical Canadian industrial diatoms are clearly shown.

CANADIAN LEAD AND ZINC.

The large annual increase in the Canadian production of lead and zinc during the last six years has been mainly due to the successful development of the Sullivan mine at Kimberley, B.C., and to the perfecting of methods of concentration and metallurgical treatment achieved by the Consolidated Mining and Smelting Company of Canada. Additional production is anticipated in the near future from several important discoveries that have been made in recent years in various parts of the Dominion; at the Flin Flon and the Sherritt-Gordon copper-zinc properties in Northern Manitoba, and at the Errington mine, near Sudbury, Ontario, where the ore is copper-zinc-lead with values in gold and silver; at the Horne, the Waite and the Aldermac mines of the Noranda Mines, Ltd., and the Amulet and Abana mines, all in Western Quebec, where the ore is copper-zinc with values in gold and silver; and in the Slocan and other areas in British Columbia, where the ores are silver-lead-zinc; at all of which active development is under way.

The successful development of so many new properties throughout Canada has been brought about mainly in the improved design and perfecting of methods of concentration and metallurgical treatment, due to the initiative of the operators themselves and, in many instances, to the co-operation of the Dominion Department of Mines, which has carried on extensive investigations in the treatment of the various complex ores above mentioned and has been ever ready with advice when required.

The total production for Canada in 1928 is estimated at 170,000 tons of lead and

100,000 tons of zinc. The present annual rate of production by provinces is as follows : in British Columbia 160,000 tons of lead and 85,000 tons of zinc, mostly derived from the Sullivan mine; at the Notre-Dame-des-Anges, Quebec, lead 3,000 tons and zinc 11,000 tons; at the Galetta mine, Ontario, lead about 4,000 tons at the Errington mine, near Sudbury, Ontario, operating a pilot mill, about 4,000 tons of zinc, 1,000 tons of lead and 800 tons of copper; from the Mayo district, Yukon Territory, about 3,000 tons of lead. The total daily milling capacity for the treatment of lead, lead-zinc and copper-zinc ores is at present about 12,000 tons.

Great activity was noticeable in 1928 in all the producing centres of British Columbia. Plant extensions, remodelling or new mills which were in progress at various properties during 1927 and 1928 contributed to the large increase in production for 1928. New mills have been constructed at the Paradise mine, Wilmer, East Kootenay; at the Whitewater and the Lucky Jim mines, near Zincton; at the Noble Five mine, Sandon, and remodelling of plant at the Ruth Hope mine, Sandon, and the Hewitt mine, Silverton. At the Sullivan mine, Kimberley, the capacity of the concentrator is being increased from 4,000 to 6,000 tons of ore a day, and enough ore has been blocked out at various mines in the country to permit a doubling of the Canadian production of lead and zinc if the metals could show a sufficient improvement in price and a large enough market was available.

The large increase in production of lead and zinc from the British Columbia mines has been followed by proportional extensions at the huge smelter works of the Consolidated Mining and Smelting Co., Ltd., at Tadanac, British Columbia, which have now a daily capacity of 500 tons of unrefined lead bullion, 400 tons of refined lead and 375 tons of bar zinc.

WORLD'S FLAX PRODUCTION.

The world's acreage of flax in an average year, according to the U.S. Agricultural Year Book, was 15,870,000 acres; of which 4,447,012 acres were for fibre and 11,432,988 acres for seed only. The fact that a much greater acreage of flax is grown for seed than for fibre *and* seed is chiefly due to one of three reasons, *viz.*—shortage of water, lack of labour, and the objectionable nature of the process of retting (rotting) the straw. This process requires some skill and much indifference to foul odours. It consists in submerging the straw until fermentation loosens the fibre from the woody portions of the straw.

When flax is grown for seed only, the sowing is sparse, so that the plants may have room to branch out, but when the objective is fibre straw and seed, it is thickly planted, so that the plants may not have room to branch, except at their tops.

Flax grown for seed on the customary sowing of 30 pounds to the acre yields an average of 8 bushels of seed to the acre, worth 10s. per bushel; most of the straw being burned to get rid of it.

The figures of the world's flax acreage in 1925 are as follows :—

Canada	1,034,874	Poland	242,006
U.S.A.	2,489,800	Lithuania	144,361
England & Wales	7,504	Latvia	132,076
Ulster	36,982	Estonia	75,365
Free State	8,288	Finland	14,776
Sweden	5,700	Russia	2,661,380
Netherlands	27,839	Kenya	7,077
Belgium	47,298	Morocco	40,924
France	45,508	Algeria	648
Spain	3,857	Tunis	5,588
Italy	51,700	Egypt	3,181
Austria	9,005	India	3,478,000
Czecho-slovakia	56,450	Japan	49,782
Hungary	7,025	Chosen	3,386
Yugo-slavia	33,179	Chile	675
Bulgaria	634	Uruguay	116,287
Rumania	40,021	Argentina	5,224,757
		Australia	452
		New Zealand	8,685

There is no other crop so universally grown as flax. Most of the flax grown in the United States, Canada, India and the Argentine is grown for seed only (for oil-cake).

The lowest priced flax on the market is Russian, which brings 23 cents per pound, and the best is Belgian, which brings 33 cents per pound.

RED TRIANGLE CEMENT ORGANISATION.

First Annual Staff Dinner.

The members of the London Staffs of Companies comprising the Red Triangle Cement Organisation were entertained to a dinner and concert at the Connaught Rooms on Wednesday, 19 December, by the Chairman and Directors of the Portland Cement Selling and Distributing Co., Ltd. Mr. Henry S. Horne presided over a gathering which

numbered nearly 450. The social character of the evening was enhanced by an infusion of the Christmas spirit, helped by its outward expression of blazing plum pudding and crackers.

After the loyal toast, Mr. John Ames (Secretary and General Manager) then proposed the toast of "The Chairman and Directors of the Red Triangle Organisation." He spoke on the question of better relationship between employers and employed and then went on to say that the Red Triangle Cement Organisation was young, less than two years old, but the work of everyone had helped to make it one of the most successful in the country and it was in their hands, however humble their position might be, to maintain that success and carry forward to greater triumphs. They recognised the statesmanship of those at the head of affairs and they dedicated themselves to another twelve months' loyal endeavour.

Rising to reply, Mr. H. S. Horne had a great reception. He admitted right away that he was very proud to be occupying the chair that night. He and his fellow Directors realised their great responsibility; in any industry these days the difficulties were very great—the problms had to be faced, as were the problems on the war, by everyone working together to one end. He looked upon the company present not as employers and employed, but as one unit, to meet as one successful body the problems they had to face in common.

He especially welcomed the members of those companies which had recently joined their Organisation. He thought it rather wonderful and a great compliment that an undertaking which had been in existence for a quarter of a century should seek to use their Red Triangle as a trade mark and "Dependability" as a slogan. He was deeply proud that another firm of 103 years' standing—a firm which had helped to give significance to that phrase, heard in many parts of the world, "on the word of an Englishman"—should be not merely willing, but enthusiastic, to join the Red Triangle Organisation.

Mr. Oliver J. S. Piper (Managing Director) also replied and pointed out that the 450 people present represented only part of the Red Triangle Organisation; the staffs of the London Offices, with a few members rel presentative of the South, the Midlands and the North. The total number was nearer 4,000 which represented probably 12,000 men, women and children dependent upon the commercial success of the Red Triangle Organisation.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

The following papers were read on Thursday, January 17:—

Measurements of the Amount of Ozone in the Earth's Atmosphere and its Relation to other Geophysical Conditions. By G. M. B. Dobson, F.R.S., D. N. Harrison, and J. Lawrence.

Daily observations of the amount of ozone in the upper atmosphere have been made at six stations in Europe during twelve months in 1926-27 with the object of finding the relation between amount of ozone and pressure distribution. These results are given, and it is shown that there is a well-marked area, with much ozone, imdemiately to the west of cyclones, while their S.W. segment often has relatively little. The amount of obone is generally small in anti-cyclones. There is a very close connection between amount of ozone and conditions in upper Troposphere or lower stratosphere. Polar air currents in upper atmosphere are generally associated with much ozone and Equatorial currents with little. There is large annual variation in amount of ozone in high latitudes but very little in low. In autumn the amount of ozone is nearly uniform over the hemisphere. New observations at more distant stations confirm these results and show that in S. hemisphere annual variation is six months different to that in N. hemisphere. Amount of ozone in New Zealand is at least as great and as variable as at corrersponding time in Europe.

The Absorption of Penetrating Radiation. By L. H. Gray. Communicated by Sir Ernest Rutherford, P.R.S.

Adopting the hypothesis that Penetrating Radiation is a type of γ-radiation, its absorption in the atmosphere is investigated from the theoretical standpoint. In order to establish contact between theory and experiment, the relation between ionisation observed in an electroscope and energy of penetrating radiation producing it is examined in some detail. It appears that ionisation is a simple function of energy and scattering absorption-coefficient of the radiation, and the mean rate of loss of energy by β-particles in walls and in gas inside electroscope. Ionisation produced in free air at any point by radiation which is initially homogeneous and isotropic at top of atmosphere is calculated by approximate methods. Compton and Dirac formulæ

lead to similar estimates of relative contributions to ionisation from primary radiation, and radiation which has suffered one or more scattering processes, but very different estimates are reached by using new scattering formulæ proposed by Klein and Nishina. Since, moreover, the wave-length corresponding to a given absorption coefficient is some five times smaller according to the new formulæ, a brief comparison is made between these and γ-ray experimental data. The degree of concordance is in general good.

The following papers were read in title only :—

The Probability of Excitation by Electron Impact. By R. d'E. ATKINSON. Communicated by F. A. Lindemann, F.R.S.

Starting from the Quantum Theory standpoint, a method is developed of analysing the results obtained by the Townsend type of experiment, in which currents of the form $i=i_0e^{ax}$ are found on varying the distance between two parallel plates in a gas at comparatively high pressures. The first critical potential and the ionisation potential are assumed already known; the mean probability that at potentials between them a collision, if it occurs, will be inelastic can then be approximately evaluated. The chief uncertainty is due to the fact that the Hertz formula cannot strictly be employed here to calculate total number of collisions occurring.

The result is applied to new measurements on Neon by Townsend and McCallum. The mean probability that collisions will be inelastic is found to be about 5 per cent. This represents sum of probabilities of *all* transitions that can occur at any one given energy. Reasons are adduced for considering this figure a plausible one.

The Products of Partial Hydrogenation of Some Higher Monoethylenic Esters. By T. P. HILDITCH AND N. L. VIDYARTHI. Communicated by E. F. Armstrong, F.R.S.

A method has been worked out whereby the constitution of the isomeric acids produced in hydrogenation of derivatives of the oleic series can be determined : the partially hydrogenated esters are oxidised in acetone solution by potassium permanganate, and the resulting mixture of mono- and di-carboxylic acid oxidation products is separated into these respective groups by distillation. Fractional distillation under reduced pressure of esters of each group of acids furnishes a series of fractions, leading to identification of the acids present. In this way it is shown that methyl esters of oleic ($\Delta^{9:10}$-octadecenoic), palmitoleic ($\Delta^{9:10}$-hexadecenoic) and erucic ($\Delta^{13:14}$-docosenoic) acids each yield a mixture of three position-isomerides, namely, the original acid, and the two acids in which an ethylenic linkage is in either of the positions adjacent to that originally occupied.

The bearing of these results upon the general theory of contact action at solid surfaces is considered; it is suggested that the already-recognised production of opposite geometrical isomeride of original ethenoid acid, and also formation of position isomers, are both due to dehydrogenation of freshly formed saturated ester prior to desorption from catalyst.

The Products of Partial Hydrogenation of Some Higher Polyethylenic Esters. By T. P. HILDITCH AND N. L. VIDYARTHI. Communicated by E. F. Armstrong ,F.R.S.

Partial hydrogenation of a polyethylenic higher fatty acid ester to the mono state, followed by disruptive oxidation of the products, is capable of giving useful information as to position of original ethylenic linkages. It is found, however, that the various ethenoid bonds are not usually hydrogenated at same rate, so that there is disparity in relative amount of monoethylenic derivatives formed. Further, the isomerisation phenomena dealt with in the preceding paper are also encountered, though in less degree than in hydrogenation of monoethylenic esters.

These complications are not sufficient seriously to interfere with the utility of the method as a means of determining constitution of polyethylenic derivatives; the latter, after selective hydrogenation to the monoethylenic derivatives, are oxidised in acetone solution by means of potassium permanganate, and the respective groups of mono- and di-carboxylic acids produced are separately converted into methyl esters and fractionally distilled.

Infra-Red Radiations of Active Nitrogen. By P. K. KICHLU AND D. P. ACHARYA. Communicated by M. N. Saha, F.R.S.

The spectrum of active nitrogen has been investigated photographically in the infrared from λ 7500 to λ 8900, and found to consist of an extension of the first positive group of nitrogen seen in the green, yellow and red regions. The most important group of lines of atomic nitrogen at about λ8200 are shown to be absent.

Perturbation Theory in Quantum Mechanics. By A. H. Wilson. Communicated by R. H. Fowler, F.R.S.

The convergence of the series of perturbations is discussed. It is shown that though the series is not in general convergent, yet it usually possesses an asymptotic character, and its use is, therefore, justified.

The Spectrum of H_2: The Bands Analogous to the Orthohelium Line Spectrum. By O. W. Richardson, F.R.S., and K. Das.

This paper extends the Q branches of the series of band systems described in "Structure, Part V," to higher vibrational levels. It also describes the P and R branches of α and β bands (2^3S-3^3P and 2^3S-4^3P) as well as a new band system with same final levels, having P and R but no Q branches (2^3S-3^3S).

Rotational analysis shows that there are two sets of non-intercombining states having a weight ratio 3 to 1. Accurate values are given for band data constants and such quantities as moments of inertia and internuclear distances for the various excited molecules 2^3S, 3^3S, 3^3P and 4^3P.

The Singlet Bands of the Hydrogen Molecule.—I. By O. W. Richardson, F.R.S., and P. M. Davidson.

This paper describes the two strongest band systems in the spectrum of H_2. They belong to 3 to 2 electron transitions analogous to those of the parhelium line spectrum. As in the α, etc., bands, there is an alternation of non-combining rotational states, with a weight ratio about 3 to 1, as evidenced by the intensity distribution in the lines. The properties of the final state are given with greater accuracy, using data taken from about 50 progressions in these and other systems. These $2'S$ states agree with the B states of Dieke and Hopfield to accuracy of ultra-violet data. Properties of initial states are also given.

On Thursday, February 7, a discussion took place on "The Structure of Atomic Nuclei." After introductory remarks by the President, Sir Ernest Rutherford, O.M., the discussion was continued by Dr. F. W. Aston, F.R.S.; Dr. J. Chadwick, F.R.S.; Dr. C. D. Ellis; Mr. R. H. Fowler, F.R.S.; and Prof. O. W. Richardson, F.R.S.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

January Examinations, 1929.—Pass List.

Examination in General Chemistry for the Associateship:

Allport, Noel Lionel (Northern Polytechnic, London); Bott, Edward Cecil Benjamin, B.Sc. (Lond.), (Loughborough College; and The Technical College, Derby); Hutcheson, William Bell (Royal Technical College, Glasgow); Moore, George, A.M.C.T. (College of Technology, Manchester); Stapley, William James, B.Sc. (Lond.) (West Ham Municipal College, London); Taffs, Basil (The University, Liverpool).

The next Examinations for the Associateship and Fellowship of the Institute will be held from 8 to 13 April, and 15 to 20 April. The list of entries will close on Monday, 11 February, 1929.

Forms of application and full particulars can be obtained from the Registrar.

UNIVERSITY SCHOLARSHIPS.

University College.

Open Scholarships in Classics.—A. S. Munro (Edinburgh Academy), F. H. Yarnold (Worcester Cathedral School), C. A. Hovenden (Charterhouse).

New College.

Open Scholarships in Classics.—N. W. G. Tucker (St. Paul's School) and E. W. S. Ford (Eton College). Open Exhibition in Classics.—O. R. Gurney (Eton College).

Exeter College.

History Scholarships.—As open scholar, W. A. P. Waddington (Wigan School); as Stapledon scholar, K. E. L. Hooper (Taunton School); as exhibitioner, E. W. Rosskill (Winchester College). Classics.—To open scholarships, J. R. Howarth (Liverpool Collegiate School) and R. L. Roberts (Highgate School); to a Waugh scholarship, M. J. Albery (Uppingham School); to a Michell exhibition, H. T. Wisdon (Dulwich College); to a Symes exhibition, R. D. F. Wild (Eton College); to an open exhibition, W. Hughes (Bishop's-Stortford School).

Queen's College.

To Open Foundation Scholarships in Classics.—J. N. D. Kelly (Glasgow University) and W. R. Elliott (St. Paul's School). To an Eglesfield Scholarship in Classics (open *pro hac vice*).—K. White (Dulwich College). To an Open Foundation Scholarship in Modern History. R. B. Pugh (St. Paul's School). To an Open Exhibition in Classics.—R. B. Cross (Shrewsbury School).

To an Open Exhibition in Modern History.—J. D. Wood (Leighton Park School, Reading).

CORPUS CHRISTI COLLEGE.

To Classical Scholarships.—E. S. F. Evans (Cheltenham College), B. Gallagher (Glasgow University) (Charles Oldham), J. R. Hawthorn (St. Edmund's Canterbury), A. M. Rendal (Rugby), A. F. Smith (Manchester), and F. L. Wormald (Leeds). To a History Scholarship.—E. F. F. White (Westminster).

The Warden of New College (Mr. H. A. L. Fisher) has been elected a foreign member of the Royal Society of Sciences of Bohemia.

GEOLOGICAL SOCIETY.

January 9, Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the chair:

Frederick Gardner Clapp, U.S.A.; Henry Dighton Thomas, M.A., Ph.D.; and Arthur Eric Jarvis Vickers, M.Sc., were proposed as Fellows of the Society.

Frank James Epps, Elinor Wight Gardner, Clement Gillman, Charles Thompson, B.Sc., Leslie Turner, B.Sc., A.M.Inst.C.E., and Cedric Clark Wilson, were elected Fellows of the Society.

The following Fellows, nominated by the Council, were elected Auditors of the Society's Accounts for the preceding year: James Romanes, M.A., and Charles P. Chatwin, M.Sc.

Prof. Owen Thomas Jones, M.A., D.Sc., F.R.S., F.G.S., delivered the following lecture (illustrated by lantern-slides) on the History of the Yellowstone Cañon (Yellowstone National Park) U.S.A.:

The Yellowstone Cañon is one of the most striking features of the Yellowstone National Park, which has long been famous for its geysers and its Tertiary volcanic rocks.

The Park has an area of 3,344 square miles, which is almost equal to the combined area of Lancashire and Cumberland.

After leaving Yellowstone Lake, the Yellowstone River flows northwards through the Hayden Valley with a very small gradient. Both around the lake and in the Hayden Valley there are remains of several post-Glacial lake-terraces. The river then drops over the Upper Fall (108 feet), and in a short distaice over the Lower Fall (309 feet). The so-called "Grand Cañyon" begins here, and extends to Tower Falls about 20 miles away to the north, where the very narrow precipitous "second Cañon" begins. At the lower end of this cañon the Yellowstone is joined by the Lamar River, which flows in a wide-open, flat-floored valley, of great size and mature aspeet. Below the junction of the rivers the so-called "third Cañon" commences, and continues downstream towards Gardiner.

The igneous rocks were described by Iddings in Monograph 32, Part II. Reference is made in this Monograph to the account of the physiography of the Park by Hague in Monograph 32, Part I. It appears, however, that the manuscript of this Monograph was not completed when Hague died, and it was never published.

Last summer Prof. Field and the lecturer examined these sediments in the company of Mr. W. J. Johnson, of the Canadian Geological Survey, and Prof. W. A. Parks, of Toronto University, and they found about 187 feet of alternating blue silts, yellow sands, and conglomerates, with a calcareous and tufaceous cement. The silts could only have been deposited in quiet water, and resemble lacustrine deposits. Similar sediments were observed on this occasion within 50 feet of the bottom of the cañon and about 100 yards of the foot of the Great Fall, and also in the ravine between the two falls where they are capped by a conglomerate at a level of about 100 feet above the Upper Fall. These sediments show that, since the cañon was eroded, it has been dammed somewhere below this locality, and filled to the brim with sediments. It is the prevalent opinion among physiographers that the cañon is of post-Glacial date, and the conglomerate capping the sedimentary series between the falls has been interpreted (E. de Martonne) as one of the Yellowstone Lake terraces. The conglomerate is, however, pre-Glacial, and appears to have nothing to do with the lake-terraces. A study of the geological maps in the folio suggests that the cañon was dammed bygreat flows of lava, which moved up it from the direction of Gardiner, and reached both the "Grand Cañon" and for many miles up the Lamar Valley. Some of these flows consist of trachytic rhyolite, but most of them consist of basalts which are now presereed as remnants on the flanks of the cañon, descending in places to within about 100 feet of its floor and rising in places to a height of nearly 8,000 feet. As the top of the sedimentary series between the two falls stands at about 7,800 feet, it is obvious that the lava-flows would be-

capable of damming the cañon to the depth necessary to allow of the formation of the sediments. The evidence of the sections exposed in the walls of the "Second Cañon" near Tower Falls clearly shows that, in that region, an older cañon lying to the east of the "Second Cañon" had been filled by alternations of basalts and conglomerate, and the present "Second Cañon" has been excavated to one side of the old blocked cañon.

A consideration of the profiles of the Yellowstone Cañon, the Lamar River, and their tributaries shows that traces of three cycles of erosion are preserved. In the Yellowstone system the first cycle is represented by the Hayden Valley, the second cycle by the "Grand Cañon," and the third cycle by the "second" and "third" cañons. The lava-flows were poured out on the floor of the valley while the third cycle of erosion was in progress. The "Grand Cañon," which belongs to the earlier or second cycle, has been eroded through the rhyolitic rocks of the Park. The basalts which followed on the third cycle are, therefore, obviously younger than the rhyolites. The conglomerate between two of the basalt-flows has yielded the remains of a Pliocene horse, and is presumably of Upper Pliocene age.

The lecturer considered that a very great interval of time intervened between the eruption of the rhyolites and the eruption of the basalts. In the folio, however, the rhyolites are regarded as being younger than the basalts and conglomerate, an interpretation which is quite inconsistent with the physiographical history of the cañon, and also with the direct evidence in the field. A perusal of Holmes's report shows that he had grasped nearly all the significant points in the geological history of the region, and there is no doubt that, given a little more time, he would have completely anticipated the results obtained by Prof. Field and the lecturer.

The general volcanic history of the Park appears, then, to have been as follows: A vast thickness of andesitic breccias was poured out, either in late Cretaceous or in early Eocene times, on a very uneven surface which consisted of rocks ranging from Pre-Cambrian to Cretaceous. A long period of erosion intervened, and the surface of the andesitic breccias was dissected into a system of mature or sub-mature valleys. On to this surface the rhyolites were poured out. There is reason to believe that the surface of the rhyolites themselves had been peneplaned, and several hundreds of feet of the upper part of the rhyolites had been removed, before the initiation of the "Grand Cañon" cycle, which was presumably the result of uplift. A further rejuvenation initiated the third cycle of erosion, represented mainly by the "third" cañon, after which the basalts and trachytic rhyolites were erupted, leading to the damming of the "Grand Cañon" and the deposition of the sediments near the falls. Since that presumed Upper Pliocene period, the basalts have been almost completely removed to a depth in places of nearly 1,500 feet, the sediments in the "Grand Canyon." have been almost cleared out, and the erosion of the cañon, which had been arrested for an enormous period of time, has been resumed.

Two facts are very significant in connection with the history of the region. One is the very large amount of material that has been removed from the whole length of the cañon since Upper Pliocene times, and the other is that the Great Fall of the Yellowstone has probably remained in its present position for an enormous period of time, and may perhaps be regarded as the oldest fall in the world.

A meeting of the Society was held on January 28, when the following communications were read.

The Glacial Geology of the Derbyshire Dome and the Western Slopes of the Southern Pennines. By Dr. A. Jowett, F.G.S., and Prof. J. K. Charlesworth, D.Sc., Ph.D., M.R.I.A., F.G.S.

The South Wales End Moraine. By Prof. J. K. Charlesworth, D.Sc., Ph.D., M.R.I.A., F.G.S.

THE CHEMICAL SOCIETY OF JAPAN.

Lectures delivered at the Memorial Meeting of the Fiftieth Anniversary of the Chemical Society of Japan:—

"The Origin and the Development of the Dyestuff Industry in Japan." By Toyokichi Takamatsu.

"The Development of the Chemical Science in Japan." By Joji Sakurai.

"The Chemistry of Metals." By Masumi Chikasige.

"The Progress of the Researches on Organic Chemistry in Japan in the Last Twenty-five Years." By Riko Majima.

"On the Polar Compounds." By Masao Katayama.

ROYAL SOCIETY OF ARTS.

Swiney Prize.

A meeting of the adjudicators of the Swiney Prize, appointed under the will of the late Dr. George Swiney, was held on Friday, January 11, at the Royal College of Physicians. Sir John Rose Bradford, K.C.M.G., C.B., C.B.E., M.D., D.Sc., F.R.C.P., F.R.S., President of the Royal College of Physicians, was in the Chair. The Chairman reported that the Committee appointed by the Royal College of Physicians had examined the works submitted for the prize and were unanimously of opinion that the prize should be awarded to Sydney Smith, M.D., Regius Professor of Forensic Medicine, University of Edinburgh, for his work "Forensic Medicine."

On the motion of the Chairman, seconded by Mr. A. A. Campbell Swinton, F.R.S., it was thereupon unanimously resolved: "That the Swiney Prize be adjudged to Sydney Smith, M.D., Regius Professor of Forensic Medicine, University of Edinburgh, for his work 'Forensic Medicine.'"

NOTICES OF BOOKS.

Volumetric Analysis. By A. J. Berry, M.A. Pp. iv + 154. London: Cambridge University Press, Fetter Lane, E.C. 1929. Price 6s.

Mr Berry's *Volumetric Analysis* merits attention if for no other reason than that it has reached its fourth edition. It gives a systematic account of the volumetric methods in general inorganic chemistry and there is one chapter devoted to a few of the simpler and more important gravimetric determinations.

In this edition a number of new exercises of greater scientific interest have been introduced whilst one or two of those included in the older edition have been deleted since they no longer possess much importance.

Modern researches have necessitated the re-writing of the chapter on the theory of indicators, and hydrogen ion concentration is now expressed on the pH scale in accordance with current practice. A feature of the work is that the oxidation reactions of potassium permanganate and dichromate are given before the sections on acidimetry and alkalimetry which are deferred till Chapter VIII.

The book is worthy of perusal by those still unacquainted with it.

Die Adsorption. By Otto Blich and Nandor Stark. Pp. 136. Brunswick: F. Vieweg. 1929. Price 7m. 75pf.

Halbmikromethoden zur Verbrennung Organischer Substanzen und Ebulliskopischen Molekulargewichtsbestimmung. By Eduarda Sucharda and Boguslav Bobranski. Pp. 38. Brunswick: F. Vieweg. 1929. Price 2m. 75pf.

These two little volumes constitute numbers 93 and 94 of the *Sammlung Vieweg* dealing with topical questions in science and technology. The first deals with the adsorption of gases and of dissolved substances by solid bodies. The authors survey the theories of gas adsorption, *viz.*, those of Eucken, Polanyi, Langmuir, Henry, Illiin, Frenkel and Jaquet. They then deal with certain experimental points and conclude with reference to the thermodynamics of adsorption.

The second volume deals with the methods recently introduced on the Continent for the rapid estimation of carbon and hydrogen (and nitrogen) in organic compounds. The apparatus is shown and described and the limits of accuracy are discussed. There is a short section on molecular weight determinations by the ebulliscopic method.

Both volumes are of interest and will doubtless appeal to those concerned with the respective branches with which they deal.

Textilchemische 'Erfindunger. Berichte über neuere Deutsche Reichs-Patente aus dem Gebiete der Färberei, Bleicherei, Appretur, Mercerisation, Wäscherei usw., der chemischen Gewinnung der Gespinstfasern, des Karbonisierens sowie der Teerfarbstoffe von Prof. Dr. Adolf Lehne. Lieferung III (1 Januar—30 Juni, 1928). Preis RM. 6. 1929. A. Ziemsen. Wittenberg, Germany.

Es ist uns eine Freude, jetzt auf die dritte Lieferung dieses sich rasch eingeführten Werkes hinweisen zu können.

Die Anlage und Behandlung der einzelnen Patente ist denkbar übersichtlich und klar. Alles Uberflüssige des oft schwülstiPatentbeschreibungen ist weggelassen, der Kern derselben ist klar und anschaulich herausgeargeitet. Jeder Fachmann kann sich leicht anhand dieser Berichte über ein Patent orientieren, es ist ihm auch möglich, fortlaufend die sein Fachgebiet betreffenden Patente stets übersichtlich und zusammenfassend kennen zu lernen. Das dies eine night zu unterschätzende Hilfe für jeden fortschrittlichen Betrieb bedeutet, braucht nicht besonders hervorgenoben zu werden.

Alles in allem mus dieses Lieferungswerk eines der angesehensten und berufensten Fachleute als ein vorzüglicher und unentbehrlicher Helfer für den Färberei- und Textilfachmann angesprochen werden, dessen Wert durch die stets gleichbleibende Aktualität infolge der halbjährlichen Erscheinungsweise noch bedeutend erhöht wird.

Tables of the Melting Points of Organic Compounds. Compiled in Japanese by PROFS. ASAHINA AND NAKAO AND DR. TSUKAMOTO. Pp. 46. Tokyo and Kyoto: Nankodo. 1928. Price $5.

In science generally and in chemistry in particular, there is much being carried out in Japan. This, however, is the first work that the reviewer has ever seen in book form from that country. It is evidently intended as a laboratory handbook for organic chemists, pharmacists and biologists who may be called upon to identify a particular compound. In its compilation the authors have apparently gone exclusively to certain German works and use their nomenclature in the western text. Whilst there may be excellent reasons for this it seems that there are equally valid ones for referring to the original literature for some of this data.

The British Journal Photographic Almanac, 1929. Ed.: GEORGE E. BROWN, F.I.C. Pp. 800 and 64 pages of photogravure supplements. London: Henry Greenwood & Co., Ltd., 24, Wellington Street, W.C.2. Price 2s. net (paper covers), 3s. net (cloth bound).

To old-time photographers and to new snapshot-camera users alike, the issue of the *British Journal Photographic Almanac* is one of the events of the year, and the appearance of the new 1929 volume therefore deserves comment. For chemists who dabble in photographic processes, there still remain lengthy reference sections dealing with standard technical methods and with items of technical progress achieved during the past year, and all photographers will find a rich source of interest in the remaining sections. The editorial article, "Photography and the Criminal," is of a kind to excite the keen interest of readers beyond the usual photographic circles. Every camera user will be interested to read an article of the making of action photographs. Further, the editorial reviews of new photographic goods—covering 76 pages—are a most welcome guide to photographic purchases. In addition there is the now usual supplement of 64 pages of photogravure reproductions of pictorial photographs, many of them real gems of camera art. The 800 pages of this current volume are completed with the usual reference sections. Among the recent advances mentioned in the new *Almanac* the most significant are those concerning the production of pictures in natural colours. Progress has also been made in the rapid production of series of snapshots. Mere chemical processes have not contributed so much to photographic practice and theory.

The editor and publishers are to be congratulated upon the continued excellence of this valuable dark-room handbook.

J. G. F. D.

Forthcoming Events.

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING AND "COMING-OF-AGE" CELEBRATIONS.

The Twenty-first Annual General Meeting will be held in the Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. on March 13 and 14. To celebrate the "Coming-of-Age" of the Institute, a Conversazione will be held at the new Science Museum, South Kensington, in the evening of March 14, in connection with which a metallurgical exhibition is being arranged. The British Industries Fair Management Committee have invited the Institute to make an official visit to the Fair on February 21.

The following papers are expected to be submitted:—

"Recent Developments in Electric Furnaces." By D. F. Campbell, M.A., A.R.S.M.

"An Improved Form of Electric Resistance Furnace." By W. Rosenhain, D.Sc., F.R.S., and W. E. Prytherch, M.Sc.

"Note on the Testing of Electro-deposits on Aluminium." By G. B. Brook, F.I.C., and G. H. Stott, B.Sc.

"The Importance of Design, and Setting of Large Kettles Used for Refining and Low Melting Point Alloys." By H. C. Lancaster.

"Brittleness in Arsenical Copper.—II." By Clement Blazey, M.Sc.

"Special Properties of Eutectics and Eutectoid Alloys in Binary Metallic Systems." By Prof. P. Saldau.

"Work-Softening and a Theory of Intercrystalline Cohesion." By F. Hargreaves, A.R.S.M., D.I.C., F.I.C., and R. J. Hills.

"The Age-Hardening of Some Aluminium Alloys." By Marie L. V. Gayler, D.Sc., and G. D. Preston, B.A.

"*The Constitution of the Cadmium-Rich* Alloys of the System Cadmium-Gold." By P. J. Durrant, M.A., Ph.D.

"The System Magnesium-Zinc." By W. Hume-Rothery, M.A., Ph.D., and E. Rounsell, B.A.

"Alloys of Zirconium.—II." By C. Sykes, M.Sc.

"The Resistance of Zinc to Indentation. (A Preliminary Account." By J. Newton Friend, D.Sc., Ph.D., F.I.C., and W. E. Thorneycroft, B.Sc.

"The Solution of Plain and Amalgamated Zincs in Electric Batteries." By J. Newton Friend, D.Sc., Ph.D., F.I.C.

"The Silver Contents of Specimens of Ancient and Mediæval Lead." By J. Newton Friend, D.Sc., Ph.D., F.I.C., and W. E. Thorneycroft, B.Sc.

"A Note on the Haughton-Hanson Thermostat. A Method of Fine Adjustment." By P. J. Durrant, M.A., Ph.D.

ROYAL SOCIETY OF ARTS.

Friday, February 8, at 9 p.m.—Mr. C. E. R. Sherrington : "Recent Problems of Rail Transport at Home and Abroad."

Friday, February 8, at 4.30 p.m.—(Indian Meeting). Captain E. J. Headlam, C.S.I., C.M.G., D.S.O., R.I.M. : "The History of the Indian Marine."

Saturday, February 9, at 3 p.m.—Dr. S. Marchant : "Music in Cathedral and Collegiate Churches."

Wednesday, February 13, at 8 p.m.—(Ordinary Meeting.) Cecil Hooper, F.L.S. : "The Pollination of Fruit Blossoms and their Insect Visitors."

Monday, February 18, at 8 p.m.—(Shaw Lecture.) Sir Thomas M. Legge, C.B.E., M.D., Senior Medical Inspector of Factories, 1898-1927 : "Thirty Years' Experience of Industrial Maladies." (Lecture I.)

Wednesday, February 20, at 8 p.m.—(Ordinary Meeting.) Major T. H. Bishop M.R.C.S., L.R.C.P., D.P.H. : "The Purification of Water."

Monday, February 25, at 8 p.m.—(Shaw Lecture.) Sir Thomas M. Legge, C.B.E., M.D., Senior Medical Inspector of Factories, 1898-1927 : "Thirty Years' Experience of Industrial Maladies." (Lecture II.)

Wendesday, February, 27, at 8 p.m.—(Ordinary Meeting.) A. F. Suter : "Resins."

THE ROYAL INSTITUTION.

Tuesday, February 12, at 5.15 p.m.—Prof. J. S. Huxley : "Evolution and the Problem of Species."

Thursday, February 14, at 5.15 p.m.—Sir William Bragg : "The Early Nistory of X-Rays."

Friday, February 15, at 9 p.m.—Dr. Eric K. Rideal : "Chemiluminescence."

Saturday, February 16, at 3 p.m.—Dr. E. Bullock : "Music in Cathedral and Collegiate Churches."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

1,544.—Bergfield, L.—Recovery of oxides of nitrogen. January 16th.

1,426.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of organic stibinic acids, etc. January 15th.

1,845.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of alkali fluorides. January 18th.

1,272.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of carbamates, etc. January 14th.

1,844.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of aromatic amines. January 18th.

Specifications Published.

296,048.—Selden Co. — Contact sulphuric acid process.

303,942.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of nitrosamine printing colours.

304,053.—Levy, S. I., and Gray, G. W.—Electrolysis of ferrous chloride.

304,071.—Takayama, Y. — Separating betaine hydrochloride and potassium chloride from waste molasses.

303,991.—Cox, K., and McDermott, P. J.—Purification of benzol, petrol, and the like.

301,384.—Granulating sodium sulphide, etc.—Kali-chemie Akt.-Ges., 10, Reichstagsufer, Berlin.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

In the production from sodium sulphide and similar chemical substances of bodies of pre-determined shape and size by allowing individual drops of the molten substance to fall on to surfaces maintained below the melting point of the substance, as described in the parent Specification, the surfaces, which may comprise sheets of metal or metal alloys, are provided with depressions to act as moulds for the bodies to be produced. Cooling may be assisted by artificial means, and the thickness of the sheets, etc., in relation to the size of the moulds is so chosen that the rate of cooling produces bodies which do not adhere to the mould and are free from internal stresses.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BIOLENE.

495,877.—Chemical substances prepared for use in medicine and pharmacy.—Arthur Rupert Beard, 114, Walton Street, London, S.W.3. January 23rd.

HELISEN.

497,915.—Chemical substances prepared for use in medicine and pharmacy.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. January 23rd.

LYSAGELS.

494,206.—Chemical substances prepared for use in medicine and pharmacy.—Solidol Chemical, Limited, 16, St. Helens Place, Bishopsgate, London, E.C.3. January 23rd.

ADSORBOLATE.

497,725.—Chemical substances prepared for use in medicine and pharmacy.—Thomas Morson & Son, Limited, 47, Grays Inn Road, London, W.C.1. January 23rd.

"EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News.*
Price 5s.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.

Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid
Specialities!

"CONTRACITE"
Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant
for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3592.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Autoxidation Boundary Pressures—Especially that of Phosphorus ... 97
By Prof. W. P. Jorissen.
General Notes ... 102
In Parliament ... 105
The Channel Tunnel ... 105
Proceedings & Notices of Societies :—
The Royal Society ... 106
The Chemical Society ... 106
Royal Institution ... 107
The Institution of Mining and Metallurgy ... 107
Royal Society of Arts ... 109
Notices of Books ... 110
Forthcoming Events ... 110
New Patents ... 111
New Trade Marks ... 112

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid. Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 28/- net.

AUTOXIDATION BOUNDARY PRESSURES—ESPECIALLY THAT OF PHOSPHORUS.

By PROF. W. P. JORISSEN.

1. *The autoxidation boundary pressure of phosphorus.*—The first to observe that phosphorus does not oxidise in oxygen at ordinary pressure was probably Fourcroy (1788)[1]. His observation was corroborated by Berthollet in 1797[2], while in the same year Fourcroy and Vauquelin[3] found that in pure oxygen at one atm. pressure the glow of phosphorus appears at 27.5° C. That phosphorescence can also be brought about at ordinary temperature by lowering the pressure was demonstrated by Bellani[4]. C. F. Schönbein[5] brought phosphorus, one half of which had been immersed in water, in contact with oxygen at the ordinary pressure. The presence of ozone could not be demonstrated (by means of potassium iodide and starch), nor did the water turn acid. At a temperature of 24° C. the phosphorus began to phosporesce and at the same time ozone was formed. Von Helwig[6] observed that phosphorus did not glow in air which had been compressed sufficiently. While Davy[7] fixed the necessary pressure at 4 atm., R. C. Marchand[8] stated that at 15° C. a pressure of 2 atm. would be sufficient. W. Müller (1870)[9] allowed phosphorus to remain in pure oxygen above water for weeks, but could not detect any decrease of the oxygen volume. Neither did phosphorus which for two months and a half had been left in contact with oxygen at about 16° C. in a sealed tube, absorb a perceptible quantity of oxygen. Müller gives about 44 cm. as the boundary pressure of "wet" phosphorus in "pure" oxygen at 10°-11° C. When he mixed the oxygen with nitrogen, the boundary pressure at 17.5° C. appeared to corerspond with a partial oxygen pressure of about 0.6 atm. J. Joubert (1874)[10] was the first to try to determine the exact pressure at which the phosphorescence appears. Of his results I need only mention the following:

FIRST SERIES.

Temp. °			Phosphorescence boundary pressure. mm.
11.5	...	...	560
14.2	...	...	650
18.2	...	...	750
19.2	...	...	760

SECOND SERIES.

Temp. °			Phosphorescence boundary pressure. mm.
11.0	...	...	495
15.2	...	...	570
16.0	...	...	595

These results show that the observations differ by about 100 mm. at 15°. Joubert *mentions that he prepared the oxygen by heating potassium chlorate*, but he does not say anything about the humidity of the phosphorus and the oxygen.

Th. Ewan (1894)[11] determined the oxidation boundary pressure by means of a manometer. In wet oxygen at 20.2—20.7° he did not observe any oxidation during 22 minutes at a pressure of 695.6 mm., while it became perceptible after 50 minutes at a pressure of 694.5 mm. At a temperature of 20.43—20.64° there was no perceptible oxidation at 728 mm. during 52 minutes; however, at a pressure of 671.1 mm. he observed *oxidation after 43 minutes.* When *he dried the oxygen by means of phosphorus* pentoxide there was no decrease of pressure at 377.0 mm. (20.87—21.26°) in 70 minutes; however, he observed a slight decrease at 201.6 mm. after 110 minutes. A much greater retardation of the oxidation of phosphorus by drying the oxygen had already been observed by H. Brereton Baker[12].

M. Centnerszwer (1898)[13] mentions 567 mm. as the boundary pressure for the phosphorescence at 20° in wet oxygen. In his observations, however, there were differences of 50 mm. The more slowly he *lowered the pressure the higher he found the boundary pressure. As he observed an intermittent phosphorescence at a pressure 50 mm. above the pressure at which con*tinuous glowing took place, the real boundary pressure must be higher than 567 mm.

E. J. Russell (1903)[14] observed that in wet oxygen at ordinary temperatures and *sufficiently high pressure no oxidation of phosphorus was perceptible even after six months.* With phosphorus which had been left in a vacuum in presence of saturated water vapour and then was brought in contact with oxygen of 1 atm. pressure dried by calcium chloride no oxidation occurred even after some months.

In the case of other experiments, where the oxygen *had been obtained in the apparatus itself* by heating potassium chlorate of potassium permanganate and had been led over concentrated sulphuric acid or phosphorus pentoxide, the phosphorus was found to react even when the pressure exceeded 1300 or 1900 mm. In all probability the presence of ozone (formed during the heating of the potassium chlorate) or of some other accelerator induced the reaction[15].

In 1905 W. P. Jorissen and W. E. Ringer[16] therefore determined the oxidation boundary pressure of phosphorus in oxygen which had been prepared some days before and was washed by solutions of potassium iodide and potassium hydroxide. The layer of phosphorus which covered a thin glass tube was kept at 15° by water from the thermostat running through the tube, the oxygen had the same temperature, and also the experiments were conducted in the absence of light. The ozone formed during oxidation below the boundary pressure was absorbed by a solution of potassium iodide.

In that way the boundary pressure at 15° in wet oxygen could be fixed between the following limits :—

No Oxidation.

Pressure	No change during
626 mm.	45 min.
601 ,,	78 ,,
637 ,,	39 ,,
604 ,,	40 ,,

Oxidation.

Pressure	Change of Pressure.
593 mm.	7 mm. of water in 22 m.
591 ,,	27 ,, ,, ,, ,, 80 ,,
602 ,,	7.5 ,, ,, ,, ,, 26 ,,

These results allow the boundary pressure to be fixed in round figures at 600 mm. (15°).

In oxygen dried by calcium chloride or sulphuric acid the boundary pressure proved to be lower, in oxygen dried by phosphorus pentoxide it was considerably lower.

In 1907 E. Scharff[17] observed at different temperatures the pressure at which phosphorus in wet oxygen begins to phosphoresce and that at which the phosphorescing stopped.

In two series of experiments he found at a temperature of 15° for the first pressure 539.2 and 565.6 mm. Para rubber served as a means of absorbing the ozone that was formed.

The phosphorescence boundary pressure differs thus considerably from the autoxidation boundary pressure found by W. P. Jorissen and W. E. Ringer. However, it is not strange that such differences are found. According to Jungfleisch[18] the phosphorescence appears almost exclusively during the further oxidation of the phosphorus tri-

oxide formed previously[19]. Manometer readings are therefore to be preferred to observations of the phosphorescence in fixing the autoxidation boundary pressure of phosphorus.

2. *Autoxidation boundary pressure in case of other substances.* — Th. Ewan (1894)[20] could not detect any oxidation of acetaldehyde-oxygen mixtures when (at a temperature of 20.6°) the oxygen pressure was higher than 530 mm. A. von Kiss and L. Demény (1924)[21] in their experiments on the oxidation of acetaldehyde did not observe, however, an autoxidation boundary. E. Scharff[22] investigated the phosphorescence boundary pressure of phosphorus trioxide in oxygen containing traces of water vapour. In two series of experiments he found at 15° resp. 301 and 318 mm., at 20° 424 and 428 mm., at 25° 448 and 470 mm. In the case of phosphorus sesquisulphide (P_4S_3) he determined the boundary pressure in dry oxygen in two series of experiments between 386.7 and 389.2 mm., and between 374.2 and 383.2 mm. (temp. 70°); between 368.4 and 387.6 mm., and between 348.2 and 367.9 mm. in wet oxygen at the same temperature. However, Miss C. Cruickshank Miller (1928)[23] observed that pure phosphorus trioxide, free of phosphorus, does not phosphoresce at ordinary temperature, neither in dry nor in wet oxygen. J. Jouhert[24] observed that sulphur at a temperature of 200° phosphoresces better in oxygen or reduced pressure than in that of ordinary pressure; similar results were obtained with arsenic. N. Semenoff and G. Rjabinin (1928)[25] found two oxidation boundaries in studying the oxidation of sulphur vapour.

The oxidation of silicon hydride[26], nickel carbonyl[27], phosphorus hydride[28] and thiophosphorylfluoride[29] is accelerated by lowering the pressure of the oxygen. W. P. Jorissen and L. Th. Reicher[30] observed, however, that at ordinary temperature nickel carbonyl is still spontaneously inflammable at an oxygen pressure of 18 atm.

The large number of substances which show autoxidation[31] tempts us to try and find the boundary pressure of these. The possibility exists, however, that this pressure will often be very high. With benzaldehyde, for instance, I observed oxidation in the dark even at a pressure of 8.2 atm.[32]

3. *Attempts to explain the autoxidation boundary pressure.* — Berthollet (1797)[33] tried to explain this pressure in the case of phosphorus. He supposed that phosphorus could evaporate (dissolve) in nitrogen but not in oxygen and must first be evaporated in nitrogen before being oxidised.

Brugnatelli[34] however, observed that oxygen in which phosphorus had been kept for some time gave luminous clouds when bubbling into nitrogen. The phosphorus therefore had evaporated in the oxygen.

C. F. Schönbein[35] gave as his opinion that phosphorus in oxygen neither phosphoresces nor oxidises at ordinary temperature "because no ozone is formed under these circumstances." R. F. Marchand[36] on the contrary attempts to explain the phenomenon by supposing an oxide film to exist and he refers to Thénard, who gave a similar explanation. W. Müller[37], however, is of opinion that we must consider pure oxygen "to have a smaller affinity." Many years later, C. Engler and W. Wild (1897)[38] gave another version of the oxide film theory. They suppose that during the oxidation of phosphorus primarily a phosphorus peroxide is formed, which dissociates when the oxidation boundary pressure is lowered. Thus they consider the oxidation boundary pressure as the dissociation pressure of the supposed peroxide. However, the boundary pressure is different every time in the presence of another (in this case chemically inactive) gas[39] and so—apart from other objections—we cannot consider the boundary pressure as a dissociation pressure.

M. Bodenstein (1899)[40] also accepts the existence of an oxide film in order to explain the boundary pressure, but he admits that this supposition is not sufficient to explain the phenomena fully.

Instead of an oxide film E. J. Russell (1903)[41] accepts another protective film. In the case of moist oxygen he says: "Water vapour does in some way form a protective film on the phosphorus surface." But, as Jorissen and Ringer found, in the case of a pressure of moist oxygen of about 600 mm. (15°) a slight lowering of the pressure (some mm.'s) brings about oxidation, an increase of a few millimeters stops it completely. Why the "film" protects the phosphorus at a pressure of say 604 mm. and not at a pressure of, say, 593 mm. Russell does not explain.

"Phosphorus is extraordinarily sensitive to surface contamination which either greatly retards oxidation or altogether stops it," says Russell to explain why others observed a boundary pressure in the case of dried oxygen while he himself did not observe it. But why, I would ask, does that

contamination cease to be troublesome at a certain low pressure?

Of quite a different nature is the explanation which R. Schenck (1904)[42] tries to give. He supposes an equilibrium between oxygen, ozone, oxygen atom ions and electrons and supposes phosphorus to become luminous by the influence of the ionised oxygen. "If now, he says, we increase the pressure of the oxygen, the concentration of the ozone will become greater at the expense of the ions. At last the number of the ions will grow smaller than the quantity which is required to make the light perceptible to the eye." As, however, a boundary pressure is not observed in the presence of ozone, Schenck's hypothesis cannot be accepted[43].

H. B. Weiser and A. Garrison (1921)[44] in their paper on the oxidation and luminescence of phosphorus, explain the boundary pressure again by supposing the formation of a film. If—so they reason—the partial pressure of the oxygen is so high that oxidation takes place faster than evaporation, the action takes place very close to the phosphorus surface and at last this surface will become coated with a film of oxide." I shall return presently to a discussion of their experiments relating to their explanation of the boundary pressure.

4. *The autoxidaton boundary pressure a lower inflammability limit.*—My researches about the flame extinguishing atmosphere[45] have led me to the following explanation of the autoxidation boundary pressure (1918)[46].

When we take a mixture of a combustible gas and air or oxygen and increase the quantity of oxygen in such a way that the percentage of the combustible gas sinks below a certain limit, the mixture cannot be ignited (by means of a spark or a flame for instance). We can now regard a mixture of phosphorus vapour and oxygen[47] in the same way. As soon as the pressure of the oxygen (and thus the percentage of that gas) rises above a certain limit, no oxidation takes place. The only difference is that in the first case at the ordinary temperature no autoxidation takes place when the percentage of the combustible gas rises above the lower inflammability limit; a spark or flame is necessary to bring about the reaction.

The boundary pressure in the case of phosphorus is the pressure of the oxygen corresponding with the lower inflammability limit of the phosphorus vapour. That the boundary pressure increases when the temperature rises (as the experiment shows[48]) is in accordance with our explanation. For the vapour pressure of the phosphorus increases with the temperature.

Lord Rayleigh (1924)[49] speaking of the suddenness with which the luminosity sets in on lowering the pressure of the oxygen: "The explosion of a powder magazine is not a more definite event than the lighting up of the phosphorus."

5. *The second boundary pressure an upper inflammability limit.*—In the first place the question arises whether there exists also an upper explosion limit for phosphorus vapour and oxygen. Joubert (1874) already observed in his "Thèses"[50], when discussing his experiments: "Thus, there would be for every temperature two limits, between which the combustion of phosphorus by oxygen might be possible, and outside which no combustion could take place. Again, to continue this train of reasoning, the question might be asked, whether the above statement forms part of a general law and, whether it simply tends to show at an ordinary temperature what would take place with hydrogen and oxygen at a temperature of 500 degrees No doubt the above are questions of a most delicate nature, on which it would be difficult to pronounce."

Lord Rayleigh (1921)[51] who studied the periodic luminosity when air is allowed to leak into an exhausted vessel containing phosphorus remarks that the formation of luminous pulses evidently requires, as oubert recognised, that a certain concentration of oxygen is reached. A theory of the propagation is proposed, which assumes that it depends on the provision of nuclei.

H. P. Waran (1923)[52] who studied the luminous pulsations in somewhat different circumstances makes the assumption "that the explosive or luminous combination of phosphorus vapour and oxygen is governed by the fact that, as in any explosive mixture, their partial pressure in the mixed atmosphere must bear a certain minimum ratio before combustion can spontaneously originate or be maintained in the mixture."

As N. Semenoff and G. Rjabinin (1928)[53] observed that sulphur vapour only burns in a certain interval of oxygen pressure, the question arises whether all combustible gases at a sufficiently high temperature—namely such a one at which autoxidation takes place—will also show the phenomenon of the autoxidation boundary pressures.

At such low temperatures at which autoxidation of a gaseous autoxidable substance does not take place, we may expect to be able to bring the mixture of oxygen or air and the vapour or gas to explosion, between two limits, by means of a spark, for instance.

6. *Influence of water vapour.*—An influence of water vapour has been observed not only in the case of the upper autoxidation boundary pressure of phosphorus, but also in that of the lower boundary pressure. As regards the upper boundary Ringer and I found[54] that the boundary pressure which is 600 mm. at 15° is lowered to about 330 mm. when the oxygen is dried by means of phosphorus pentoxide (but not so completely as in H. Brereton Baker's experiments[55]. The influence of water vapour on the lower boundary pressure was observed by Lord Rayleigh[56]. The influence of water on the explosion limits of several gases is well known. H. Dixon[57] found that a perfectly dry mixture of carbon monoxide and oxygen will not explode if sparked, the explosion, however, taking place more easily in proportion as the quantity of water vapour increases (within certain limits)[58]. We can therefore expect that the lower inflammability limit of combustible gases will increase when the amount of water vapour decreases, just as is the case with phosphorus vapour.

REFERENCES.

1 *Hist. acad. roy. sci.*, année 1788, avec *les mém. de math. et de phys.*, p. 367.

2 *J. polytech. I*, 3e cah., 274 (an 3).

3 *Ann. chim.*, 1797, XXI, 196.

4 *Bull. pharm.*, 1818, V, 489, also J. S. C. Schweigger, *J. Chem. u. Phys.*, 1824, XL, 16.

5 *Ann. Phys.* (Pogg.) (3), 1848, XV, 368.

6 and 7 cited by Marchand.

8 *J. prakt. Chem.*, 1850, L, 6.

9 *Ber.*, 1870, III, 85.

10 *Thèses*, Paris, 1874, 27.

11 *Phil. Mag.* (5) 1894, XXXVIII, 512; *Z. physik. Chem.*, 1895, XVI, 325.

12 *Phil. Trans.*, 1888, CLXXIX, 571.

13 *Z. physik. Chem.*, 1898, XXXVI, 21.

14 *J. Chem. Soc.*, 1903, LXXXIII, 1279.

15 Freshly prepared gases possess a notable conductivitf, see, *e.g.*, T. Bloch, *Ann. chim. phys.* (8) 1905, IV, 25.

16 *Chem. News*, 1905, XCII, 150.

17 *Z. physik. Chem.*, 1908, LXII, 188.

18 *Compt. rend.*, 1905, CXL, 441; 1907, CXLV, 325.

19 Compare also L. Bloch, *Ann. chim. phys.*, 1911, XXII, 503.

20 *Phil. Mag.* (5), 1894, XXXVIII, 530; *Z. physik. Chem.*, 1895, XVI, 340.

21 *Rec. trav. chim.*, 1924, XLIII, 221; in the presence of an excess of oxygen the oxidation velocity, however, was much smaller.

22 *Z. physik. Chem.*, 1908, LXII, 185.

23 *J. Chem. Soc.*, 1928, 1847.

24 *Thèses*, Paris, 1874, 16-17.

25 *Z. physik. Chem.*, B. 1928, I, 192.

26 C. Friedel and A. Ladenburg, *Ann. chim. phys.* (4), 1871, XXIII, 440.

27 M. Berthelot, see H. J. van de Stadt, *Z. physik. Chem.*, 1893, XII, 322.

28 Houton-Labillardière, *Ann. chim. phys.* (3), 1877, VI, 304; J. H. van't Hoff, *Etudes de dynamique chim.*, 1884, 60; H. J. van de Stadt, *Z. physik. Chem.*, 1893, XII, 322.

29 T. E. Thorpe and J. W. Rodger, *J. chem. Soc.*, 1889, LV, 306.

30 *Maandblad Natuurwetensch.*, 1894, No. 1.

31 See for instance W. P. Jorissen, *Chem. Weekblad*, 1904, I, 799.

32 *Chem. Weekblad.*, 1904, I, 805.

33 *J. polytechn.*, 1797, I, 805.

34 *Ann. chimica e hist. nat.*, 1797, XIII, 295; *Ann. chim.*, 1797, XXIV, 58.

35 *J. prakt. Chem.*, 1845, XXXVI, 249.

36 *Ibid.*, 1850, L, 10.

37 *Ber.*, 1870, III, 89.

38 *Ibid.*, 1897, XXX, 1680.

39 J. Joubert, *Thèses*, 1874, 31-43.

40 *Z. physik. Chem.*, 1899, XXX, 137.

41 *J. Chem. Soc.*, 1903, LXXXIII, 1281, 1273.

42 *Sitz. Ber. Preuss. Akad. Wissensch. phys. mathem. Cl.*, 7 Jan., 1904.

43 See also W. P. Jorissen, *Chem. News*, 1905, XCII, 62.

44 *J. Phys. Chem.*, 1921, XXV, 61, 349, 473.

45 I showed that there is a close similarity between the upper limit of inflammability of gaseous mixtures and the flame extinguishing atmosphere; in both cases the proportion of oxygen is the same, see W. P. Jorissen and N. H. Siewertsz van Reesema, *Chem. Weekblad*, 1909, VI, 1053; *Z. physik. Chem.*, 1910, LXXIII, 163; *Arch. néerl.* (3) A, 1911, I, 15; W. P. Jorissen, *Chem. Weekblad*, 1913, X, 961, *Het Gas*, June, 1914.

[46] *Chem. Weekblad*, 1918, xvx, 709; *Rec. trav. chim.*, 1920, xxxix, 717; 1921, xl, 539.

[47] That phosphorus evaporated in oxygen of a pressure of 1 atm. (without oxidation taking place) and the vapour pressure attains the same value as in hydrogen, for instance, was shown by M. Centnerszwer, *Z. physik. Chem.*, 1913, lxxxv, 99.

[48] Whereas I found the autoxidation boundary pressure to be about 600 mm. in wet oxygen at 15° C., C. F. Schönbein, *Ann. Phys.* (Pogg.) (3) 1848, xv, 368, observed that phosphorus becomes luminescent in wet oxygen of 1 atm. at a temperature of 24°.

[49] *Proc. Roy. Soc.*, A, 1924, cvi, 3. He takes no account of the formation of ozone which explains the "hysteresis" observed.

[50] Pages 15 and 16.

[51] *Proc. Roy. Soc.*, 1921, xcix, 372.

[52] *Phil. Mag.*, 1923, xlv, 1132.

[53] *Z. physik. Chem. B*, 1928, i, 192.

[54] *Chem. News*, 1905, xcii, 150.

[55] *Phil. Trans. A*, 1888, clxxix, 583, He observed that dry phosphorus is not attacked by dry oxygen (both dried in an extraordinary way) "though the pressure was varied in every possible way," even not at the boiling point of phosphorus (290°).

[56] *Proc. Roy. Soc.* A, 1921, xcix, 372.

[57] *Phil. Trans.*, 1884, clxxv, 617.

[58] A. F. Girvan, *Proc. Chem. Soc.*, 1903, xix, 236, found that the quantity of water necessary for rendering possible the explosion of a mixture of carbon monoxide and oxygen, is 1 mol. for 24000 mol. of gas.

(To be continued.)

GENERAL NOTES.

BOARD OF TRADE ANNOUNCEMENT.

Dyestuffs (Import Regulation) Act.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during January has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 616 of which 532 were from merchants or importers. To these should be added 4 cases outstanding on the 31 December, 1928, making a total for the month of 620.

LEAD AND ZINC IN CANADA.

By Arthur Buisson.

(Canadian Department of Mines.)

The large annual increase in the Canadian production of lead and zinc during the last six years has been mainly due to the successful development of the Sullivan mine at Kimberley, B.C., and to the perfecting of methods of concentration and metallurgical treatment achieved by the Consolidated Mining and Smelting Company of Canada. Additional production is anticipated in the near future from several important discoveries that have been made in recent years in various parts of the Dominion; at the Flin Flon and the Sherritt-Gordan copper-zinc properties in Northern Manitoba, and at the Errington mine, near Sudbury, Ontario, where the ore is copper-zinc-lead with values in gold and silver; at the Horne, the Waite and the Aldermac mines of the Noranda Mines, Ltd., and the Amulet and Abana mines, all in Western Quebec, where the ore is copper-zinc with values in gold and silver; and in the Slocan and other areas in British Columbia, where the ores are silver-lead-zinc; at all of which active development is under way.

The successful development of so many new properties throughout Canada has been brought about mainly in the improved design and perfecting of methods of concentration and metallurgical treatment, due to the initiation of the operators themselves and, in many instances, to the co-operation of the Department of Mines, which has carried on extensive investigations in the treatment of the various complex ores above mentioned and has been ever ready with advice when required.

The total production for Canada in 1928 is estimated at 170,000 tons of lead and 100,000 tons of zinc. The present annual rate of production by provinces is as follows: In British Columbia 160,000 tons of lead and 85,000 tons of zinc, mostly derived from the Sullivan mine; at the Notre-Dame-des-Anges, Quebec, lead 3,000 tons and zinc 11,000; at the Galetta mine, Galetta, Ontario, lead about 4,000 tons; at the Erring-

ton mine, near Sudbury, Ontario, operating a pilot mill, about 4,000 tons of zinc, 1,000 tons of lead and 800 tons of copper; from the Mayo district, Yukon Territory, about 3,000 tons of lead, lead-zinc and copper-zinc ores is at present about 12,000 tons.

Great activity was noticeable in 1928 in all the producing centres of British Columbia. Plant extensions, re-modelling or new mills which were in progress at various properties during 1927 and 1928 contributed to the large increase in production for 1928. New mills have been constructed at the Paradise mins, Wilmer, East Kootenay; at the Whitewater and the Lucky Jim Mines, near Zincton; at the Noble Five Mine, Sandon, and the Hewitt Mine, Silverton. At the Sullivan Mine, Kimberley, the capacity of the concentrator is being increased from 4,000 to 6,000 tons of ore a day, and enough ore has been blocked out at various mines in the country to permit a doubling of the Canadian production of lead and zinc if the metals could show a sufficient improvement in price and a large enough market was available.

DIATOMACEOUS EARTH IN CANADA.

The Mines Branch of the Dominion Department of Mines has just published Report No. 691 by V. L. Eardley Wilmot, entitled, "Diatomite—its occurrence, preparation and uses," copies of which can be obtained by persons interested on application either to the Department of Mines at Ottawa or to the High Commissioner for Canada, The Canadian Building, Trafalgar Square, London, S.W.1.

The Report contains a general description of the material in question, discussing its origin, formation, composition, properties and uses, and gives information relative to the Canadian deposits and respecting tests which have been made with diatomite of Canadian production.

The author, in his introduction, states that although the number of industries in which diatomite is being successfully used is increasing rapidly, the great possibilities of this material are not as yet realised by many who might benefit by knowledge of its uses. At the present time, diatomaceous earth has been used in connection with heat, cold and sound insulation; as a filtering medium; as a carrier for catalytic agents; as an absorbent; as a filler; as a mild abrasive in polishes; and as a structural material; and some grades are capable of bleaching and of being used in a similar manner to fuller's earth, as well as in substitution for silica sand or ground quartz in the manufacture of some compounds. There are many further miscellaneous uses.

NOVA SCOTIA INSTITUTE OF SCIENCE.

Founded some 67 years ago, the above Institute is apparently in a healthy condition, judged by the number of excellent papers submitted during each session. During the 1926-7 session a successful science exhibition was held in co-operation with the Science Department of the Dalhousie University, which was attended by about 5,000 persons. During the same session the Government grant was restored after a lapse of 20 years. From the Report we learn that the committee in charge received enthusiastic support and co-operation from the Science teaching staffs and students of Dalhousie University, the faculty and students of the Maritime College of Pharmacy, the electrical department of the Nova Scotia Technical College, the Atlantic Experiment Fisheries Station and radio-station CHNS.

POWER GENERATION DEVELOPMENTS.

Views of Birmingham's Chief Electrical Engineer.

A notable development in modern power production is the great increase in steam pressures used in power station steam-raising plant. A few years ago it was quite exceptional to find boiler pressures of more than 300 lbs. per sq. inch in use. To-day we find in some American and Continental plants pressures as high as 1,200 aud 1,400 lbs. being used, while a large industrial plant, which is now being constructed by the Combustion Engineering Corporation of America, will employ a pressure of 1,800 lbs. In some cases, with special or experimental boilers, over 3,000 lbs. has been tried. While in this country such excessive pressures have not come into use, the tendency in power stations here is definitely towards higher pressures with the object of increasing efficiency. It will be recalled that at the Kirkstall power station, Leeds,

now under construction, a pressure of 490 lbs. will be used, while the order just placed for Battersea new super power station specifies 600 lbs. So far this has only been exceeded in Great Britain by the installation at the Stockton-on-Tees plant of Synthetic Ammonia and Nitrates, Ltd., which represents the largest steam-raising plant in the country and also employs the highest pressure, namely, 850 lbs. per sq. inch.

Discussing this question recently, Mr. R. A. Chattock, the chief electrical engineer to Birmingham Corporation, recalled that 25 years ago 150 lbs. was considered a high figure. Whether the high cost of apparatus, including boilers, piping, etc., necessitated with such figures as 1,200 lbs., and over, was justified by the higher thermal efficiency obtained, he considered rather doubtful. The new Hams Hall Birmingham station, which is now nearing completion, will employ a pressure of under 400 lbs.

It is interesting to note that in nearly all cases the employment of high pressures is accompanied by pulverised fuel firing, a system which has made astonishing progress during the last few years. Apart from the high efficiency of combustion which pulverised fuel firing gives, a very important feature is its capacity to use effectively low-grade coal. During the strike period fuel having as much as 45 per cent. ash was used at the existing Birmingham stations, with the "Lopulco" pulverised fuel system and full duty was obtained from the boilers so fired, although on the stoker-fired boilers this low-grade material could only be burned by mixing it with better-class fuels.

British combustion engineering stands foremost in the world in its attainments and although this country may not be able to show examples of such radical departures in practice as are to be seen in America and on the Continent, British practice is showing some of the best results in the world.

LOW GRADE FUEL UTILISATION.

Another Example of Steam Generation Economy.

Scientific methods with coal is one of the most vital factors in the world to-day, and in this connection highly significant for example is that the demand for solid fuel only increases at a very slow rate. For example the latest figures for 1927 estimate the world's coal (and lignite) production as about 1,450,000,000 tons, and 15 years ago the figures were 1,350,000,000 tons.

Two of the chief causes of this state of affairs are the remarkable growth of water-power, with about 40,000,000 h.p. installed, as compared with 29,000,000 h.p. in 1923, and also the rapid increase in the production of petroleum, which has now, both in 1927 and almost certainly in 1928, passed the figure of 1,250,000,000 barrels per annum. But it is perhaps not generally realised that other factors also enter into the question, particularly for example the more scientific use of coal, that is increased thermal efficiency, and also the better utilisation of low grade material, including for example small slack, breeze from coke oven plant, and refuse material from coal washeries. Typical of the trend of events are the results of a recent test carried out at a well-known iron and steel works on the North-East Coast.

The normal practice in this particular works was to use a screened bituminous coal costing 16s. 9d. per ton giving an evaporation of 8.43 lbs. of water per lb. of coal, corresponding to 8.75 lbs. from and at 212° F., which incidentally is much better than the average practice. The steam generation plant with "Lancashire" boilers was then fitted with the "Turbine" forced draught steam jet furnace, and there is now being burnt "Pond Duff" (washery settlings), costing 6s. 9d. per ton delivered, which seems a high price. However, the result is a great success, corresponding to no less than about 50 per cent. reduction in the nett cost of steam generation, while in addition the output of the plant has been increased by nearly 30 per cent., the evaporation being about 150,000 lbs. of water as against a previous figure of 118,000 lbs. using ordinary good class screened coal.

The performance is approximately 6.70 lbs. of water per lb. of Pond Duff, equal to 7.06 lbs. from and at 212° F., but the difference in the price of course means an enormous nett reduction, while it may be stated further that the hourly evaporation per individual "Lancashire" boiler with Pond Duff is 6,350 lbs., whereas the screen coal figure was 4,918 lbs.

Naturally what can be accomplished in the field of utilisation of low grade fuels depends very largely on the individual conditions, but here is a concrete case of a well-known firm cutting their coal bill in half.

RECORD CANADIAN COKE PRODUCTION.

The Dominion Bureau of Statistics at Ottawa reports that during the third quarter of last year, 585,359 tons of coke were produced in Canada, the output being 20 per cent. in excess of the tonnage reported for the corresponding period of 1927. Production during the nine months ended September 30 last totalled 1,680,550 tons, an increase of 11 per cent. over the 1927 figure for the same period and of 18 per cent. over the corresponding figure in 1926.

Coke charged to iron blast furnaces in Canada during the nine months ended September 30 totalled 812,739 tons as against 639,674 tons during the first three quarters of 1927.

In Parliament.

CHLORINE IN FLOUR.

Lieut.-Colonel Heneage asked the Minister of Health if his attention had been called to the use of chlorine for improving certain inferior grades of foreign flour; and if it is proposed to take any action in the matter?

The Parliamentary Secretary to the Ministry of Health (Sir Kingsley Wood): My right hon. Friend is aware that chlorine is sometimes used for the treatment of flour, but he understands that its use is diminishing, and, having regard to such considerations as the danger of increasing the cost of bread and of driving the milling trade abroad, he is not at present proposing to take any action in the matter.

Lieut.-Colonel Heneage: Has my right hon. Friend's attention been called to the fact that this is disadvantageous to the British producer of wheat as well as to the British consumer.

Sir K. Wood: I am not aware of that, but, if my hon. and gallant Friend has any information, I shall be glad to consider it.

RADIUM.

Mr. R. Morrison asked the Minister of Health, in view of the necessity for an adequate supply of radium, when he expects to receive the Report of the Sub-Committee of the Committee of Civil Research?

Sir K. Wood: The Sub-Committee will not report to my right hon. Friend and he cannot say when their Report will be received. But my right hon. Friend has arranged for the inquiries made on the subject in the House to be brought to the notice of the Sub-Committee and he trusts that their Report will be available at an early date.

Mr. Morrison: Is it not a fact that the lives of thousands of people in this country are seriously endangered because they are unable to receive this treatment? Could not the Ministry of Health publish such information as they have for use in the hositals, and is any attempt being made by holding supplies back to force up the price? Is not the Ministry of Health interested in this matter?

Sir K. Wood: The Ministry of Health is very much interested in it, and I think it would be far better to await the Report of the sub-committee that has been set up to deal with the matter.

Mr. Morrison: Shall we have their Report at an early date?

Sir K. Wood: My right hon. Friend has communicated to the sub-committee questions such as the hon. Member has put with a view if possible of expediting the matter.

Mr. Morrison: If I put down a question in a fortnight's time, does the right hon. Gentleman think we shall have the Report?

Sir K. Wood: It is impossible to say when the sub-committee will report, but I may be able to communicate with the hon. Member.

THE CHANNEL TUNNEL.

NOT ONE ORGANISATION AGAINST.

Fifteen Chambers of Commerce have written to Sir William Bull, M.P., Chairman of the Channel Tunnel Parliamentary Committee, approving of the proposal to link this country to France by a tunnel under the Channel.

The Chambers who support the plan are Bath, Chelmsford, Coventry, Fraserburgh, Fulham, Great Grimsby, Luton, Macclesfield, Margate, Richmond, Tonbridge, Uckfield, Walsall, Widnes, and Great Yarmouth. Fraserburgh points out that "the Tunnel would be the means of allowing quick despatch for fresh fish to the European markets, a thing badly wanted but at present impossible except in large cargoes iced."

Sheffield Chamber of Commerce feel that it is undesirable to anticipate the Special Committee set up to investigate the problem but they have adopted a resolution welcoming that step.

The Liverpool Chamber has invited Sir William Bull to luncheon in order to be informed of the engineering and economic aspects of the proposal before coming to a decision. Amongst other chambers who are to discuss the question in the immediate future are those of Cardiff, Edinburgh, Glasgow, Manchester, Middlesbrough, and Swansea.

One hundred and eight Labour organisations throughout the country have intimated to Sir William Bull their unanimous support of the project. The Dunfermline party asks whether Sir William is also in favour of a road bridge over the Forth, and the Central Hull Divisional Labour Party would like a tunnel under the Humber proceeded with "at the earliest possible moment."

No Chamber of Commerce or Labour body has thus far declared against the Channel Tunnel plan.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, January 24.

The Combination of Proteins, Amino-Acids, Etc., with Acids and Alkalis. Part II. Titration Curves of Amino-Acids, in Presence of Formal. By L. J. HARRIS. Communicated by Sir Frederick Hopkins, F.R.S.

Curves are given for variation in p_H value (colorimetrical) with amount of soda added when amino-acids are titrated in aqueous formaldehyde, each addition being corrected for the acidity of the "solvent." For a constant formaldehyde concentration the corrected curve for each anion-acid conforms throughout with Henderson-Hasselbash equation for a simple acid possessing determinate p_H value. Apparent dissociation constants are calculated, as though dealing with a simple acid substance (methylene derivative of amino-acid in question).

In concentrations as usually employed in Sorensen titration the apparent p_H values are approximately 3 units less than for corresponding free amino-acids in aqueous solution. Thus rationale of method is formation of methylene derivatives in equilibrium with amino-acids having resultant NaOH-titration curves and p_H end-points displaced 3 units to less alkaline side of p_H scale. Within common limits in Sorensen estimation apparent p_H value remained practically unaffected by ratio amino-acid/formaldehyde, or by concentration of acid, formaldehyde concentration being constant. On the other hand, progressive decrease of p_H values occurred with increasing formaldehyde concentration, the net effect recalling that of change in "medium"—such as addition of alcohol—where alteration in dielectric constant is involved.

The Effect of X-Radiation on the Spermatogenesis of the Guinea-Pig. By J. B. GATENBY AND SYLVIA WIGODER. Communicated by J. P. Hill, F.R.S.

X-radiation prevents mitosis in those cells entering prophase. It is suggested that the X-radiation breaks up lipoids in some way essential to mitosis. Primary and especially secondary spermatocytes become spermatid-like and begin to form acrosomes, but soon die. In the insect Lepisma, X-radiation causes the Golgi bodies to swell. Mild doses of X-radiation cause only temporary interference with lipoid metabolism, so that cells not already entering prophase of mitosis are able to recover. No evidence of stimulation effects by X-rays was procured.

THE CHEMICAL SOCIETY.

Papers read on Thursday, February 7:—

Indian Turpentine from Pinus longifolia *Roxb. Part X. The Oxidation of* d-Δ^3-*carene with Beckmann's Chrome Acid Mixture.* By C. S. GIBSON AND J. L. SIMONSEN.

The action of Beckmann's chromic acid mixture on *d*-Δ^3-carene has been examined. The main products of the reaction were *l*-*trans*-caronic acid and terpenylic acid; *cis*-caronic acid, terebic acid, dimethylmalonic acid and *d*-homo-terpenyl methyl ketone were formed in small amounts. Attention is directed to the possible significance of the formation of *l*-*trans*-caronic acid on the configuration of the terpene. Treatment of the hydrocarbon with sulphure acid in acetic acid solution affords a diterpene.

A New Method for Preparing Substituted Diphenylamines. By A. W. CHAPMAN.

Diphenylamines with similar or different substituents in the two nuclei may be prepared from substituted amines and phenols

through the corresponding benziminoethers. When heated these latter yield benzoyldiphenylamines which can be hydrolysed with alcoholic potassium hydroxide to the free bases.

Compounds of the Tryparsamide Type. Part I. Resolution of N-phenylalanine-4-arsinic Acid and of its Amide. By C. S. Gibson, J. D. A. Johnson, and B. Levin.

10-Chloro-5 : 10-dihydrophenarsazine and its Derivatives. Part VII. The Synthesis of the 1-methyl- and 3-methyl Homologues. By C. S. Gibson and J. D. A. Johnson.

ROYAL INSTITUTION.

At a General Meeting of the Members of the Royal Institution held recently, Sir Arthur Keith, Treasurer and Vice-President, in the chair, Lord Glenconner, Lord Holden, Mr. Douglas Betts, Mr. C. Cuthbertson, Mr. A. Fraser, Mr. W. Matthews Hill, Mr. C. W. Marshall, Mr. T. Martin, Mr. S. North, Mr. W. G. Plummer and Mrs. F. M. Tiller were elected Members.

THE INSTITUTION OF MINING AND METALLURGY.

Third Ordinary General Meeting (38th Session) held on Thursday, December 20, 1928, at the Rooms of the Geological Society, Burlington House, Piccadilly, London, W.1., Professor S. J. Truscott, President, in the Chair.

Discussion on—

The Importance of Recovered or "Secondary Tin." By J. B. Richardson, Associate.

Mr. J. B. Richardson said it was with trepidation that he submitted these notes on a somewhat unusual subject, realising that a large number of the members of the Institution, closely interested in mining and smelting of tin ores, might incline to the view that virgin metal only should be used for all tin manufactures and alloys, and that the recovery of "secondary" tin was hardly a fit subject for discussion, even though another country recovered last year a tonnage amounting to nearly half the aggregate of virgin tin that she consumed.

But his excuse was that if, within a quarter of a century, there should be a diminution of fresh supplies, coupled with an increased demand, and the continuance of the present dissipation and dilution of tin to the point that the recovery of a great part of it was uneconomic, then there was already a real need to study the saving and recovery of tin in any form.

Sir Thomas Holland, in his "Proposed Review of the Mineral Resources of the Empire," discussed the position of the tin supplies in the event of a great social upheaval. If outside sources were suddenly cut off, this country would be forced to live on the tin (and other metals) in current use, re-smelted and manufactured to the requirement of the moment. For this reason also the means of preserving and recovering used tin to the utmost were important, because in such event this "secondary" tin would form the main supply of the country until communications opened up again.

Turning to the notes themselves, in order to disarm a certain amount of criticism, the gaps in figures and facts were due to the information asked for in a number of directions not being supplied.

Since writing the paper he had read the very interesting article by Gibson Buttfield, published in New York, who stated that one-third of the total tin employed in weighting silk passed on with the wash waters in a very diluted state. Incidentally this writer claimed to be able to reduce by his method practically the whole of this residue tin as oxide.

The author had put forward suggestions that could never all be fully achieved, and those that could be achieved would take years to accomplish, but there was an old North Country saying, "If you ask, you don't get; if you don't ask, you don't want."

It was perhaps the very fact that because this section of the tin industry, with few exceptions, was a small man's business, and was so closely allied to the scrap-metal trade, that it had not had the attention it deserved in this country from the metallurgical profession. It was not so much because the profession had turned up its nose at this industry as that the individual enterprises concerned, always with the few exceptions, had not been able to afford to employ the necessary talent. This had led, unhappily, to the exploitation—or rather, exploration—of the many smaller concerns by unscrupulous persons offering all sorts of wonderful secret processes, the price, no doubt, being varied to suit the pocket of the intended victim.

To show that this was no exaggeration, he gave a translation of a document that had recently come to his office. It was headed "Dissociation of White Metal Alloys," and read:

"I venture to enquire if you would be interested in a simple process by which any given white metal alloy can be separated into its component tin, lead, copper, and antimony. The various constituents are won with the following purities: Tin. 99.9 per cent.; lead, 99.6 per cent.; copper, 99.7 per cent.; antimony, 99.6 per cent.

"The complete plant, which yon can erect at your own works from my plans for about £100, consists of a metallurgical furnace, piping, fore-hearths, etc. The products are won as metals, and have merely to be re-melted and cast into the form required after being tapped from the forehearths.

"I would let you have all the plans for erection and exact instructions to enable you to carry out the smelting yourselves for £30."

This offer to him savoured more of alchemy than metallurgy, but members would appreciate that men with no technical knowledge, or with only a smattering, might easily think there was something in it, accept, and pay for the offer. Being once bitten, they became twice shy, sceptical of new processes, and improvements, preferring to carry on with wasteful methods, which tended all the time to the diminution of the world's store of useful tin.

Finally, he expressed the hope that the subject might be considered of sufficient importance for it to be proposed that the Institution, which was so closely associated with the other branches of the producing industry, submitted to the right and proper quarter the suggestion for the collection and publication of annual statistics on the recovery of used tin in this country—if not as a separate suggestion, at least as part and parcel of a bigger and more comprehensive scheme of statistical information.

The President said that the *Transactions* of the Institution had frequently been the repository for communications on the subject of tin, but hitherto these had dealt as a rule with the mining and dressing of the ore. He welcomed a paper which dealt with the metallurgy of tin; they still had to get a paper dealing with the smelting of tin. He was particularly pleased with the present paper in that it represented a good deal of the author's own work; and in addition was well documented. With regard to the point the author had just raised, about the Institution collecting statistics, probably this was outside its province. It might be within the province of some industrial organisation parallel with the Institution, did such an organisation exist. But such an organisation did not exist at the present moment.

Professor J. G. Lawn said that the paper was certainly one of very great importance, for which the Institution was much indebted to Mr. Richardson. There was no doubt that the question of the recovery of "secondary" tin would become increasingly important. From the narrow point of view, mining engineers might at first sight be inclined to say, "we want to see the price of tin go up, and therefore we are not very keen on seeing too much of the old metal recovered." But this would be an exceedingly narrow point of view, because, as the supplies of tin got less in the years to come—which seemed inevitable from all the knowledge they had of the occurrences —the price of tin must inevitably rise, and the recovery of tin would not in the end affect the price of the metal because there would always be a surplus required from mines and alluvial workings, and that surplus would control the price. Moreover, the rise in price would be a further incentive to those who were studying from the metallurgical point of view this question of recovery, would lead to money and research being devoted to this object, and to the organisation of the industry on the lines that Mr. Richardson evidently had in mind.

Mr. Richardson raised a point, which was one of great interest, about the dissemination of knowledge, the publication of the results of experience and research. This was of interest in all branches of mining and metallurgy, but presented a great deal of difficulty. The speaker supposed that there was no mining centre in the world which published information more freely and readily than the Rand, with which district he was particularly acquainted. This had been of the greatest benefit. But the advantage of the Rand in this respect was that the product dealt with was one for which there was no difficulty in finding a market, and which did not vary in price. Therefore, it was to the advantage of everybody that information should be disseminated. The only question which arose was that of the reward to the inventor, and it was to his advantage that full information as to his

improvements should be circulated to everybody. Where the process could be patented, he, of course, controlled his own reward. Where the process could not be patented there was a scheme initiated by the Transvaal Chamber of Mines whereby the inventor should steill receive some reward for his invention—not a reward as to which he could dictate, but such a reward as a committee of those interested considered reasonable and right, taking into account the importance of the invention and the labour and time he had expended in bringing it about.

But when one came to such a position as that raised in the paper, different considerations applied. It was not merely a matter of the reward to the inventor of the process, but the process might in itself be of such a nature that it acted as an instrument whereby business could be secured. There was not only reward in possible increase of profits, due to improvements in the process, lower working costs, and more efficient results, but also reward in the sense that a business might be built on the basis of the invention, and this made it exceedingly difficult to secure, what he was eure they all regarded as highly desirable, the dissemination of knowledge and experience with regard to new processes.

It seemed to the speaker that at the present time the best that could be done was what Mr. Richardson had done in this paper, namely, to get together a summary of all published accounts and compare results. Mr. Richardson was quite right in thinking that there should be a collection of statistics available to all those interested in this question, and although the President had rightly pointed out that this was not within the province of the Institution, still the Institution might give consideration to the question, see what Government or other body would be most suitable, and possibly bring this matter, together with other matters of a similar nature, to its notice, and thus secure a public benefit.

There was just one other point, not really dealing with "secondary" tin, but included in the paper because the processes employed had some analogy to those used in extracting "secondary" tin, namely, the treatment of impure low-grade ores. That, of course, was in use to-day, and the tin miners in Cornwall could, if they wished, get quotations for treatment of these low-grade ores by works which were dealing regularly with this kind of ore. The trouble was that the returning charges were very high, and the miner had to make out a balance sheet as between sending his impure ore to such smelters and dressing it himself to a much higher degree of purity, in which case he lost a certain amount of tin and bore the cost of the extra dressing. That being the position, one naturally sympathised with Mr. Richardson in his wish to see better processes developed, because they would be, without doubt, of great advantage to the tin miner in many districts.

(*To be continued.*)

FARADAY MEDAL AWARDED TO ITALIAN.

The Council of the Institution of Electrical Engineers have made the eighth award of the Faraday Medal to Signor Guido Semenza, of Milan. This medal is awarded by the Council of the Institution either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country, or residence, or membership of the Institution.

Signor Semenza has for many years taken a leading part in the development of the applications of electricity.

ROYAL SOCIETY OF ARTS.

COMPETITION OF INDUSTRIAL DESIGNS.

Particulars of the Sixth Annual Open Competition of Industrial Designs to be held at the Imperial Institute, South Kensington, London, S.W., in June, 1929, have now been issued, and can be obtained from the Secretary of the Royal Society of Arts, John Street, Adelphi, London, W.C.2. Intending Competitors must apply to the Secretary of the Society between May 1 and May 11 for the necessary forms and the last day for receiving entries is May 27. In all, Scholarships and Prizes amounting to over £2,000 are offered in connection with the 1929 Competition.

The Royal Society of Arts offers a prize of £50 for designs for a proscenium wall of a cinematograph theatre; a prize of £20 for a set of black and white drawings of architectural subjects; and prizes of £25 and £10 for a scheme for the complete decoration and furnishing of a middle-class bedroom.

Three scholarships will also be awarded—one of £75 for designs suitable for weaving or printing intended for dress or furnishing materials offered by the Tootal Broadhurst Lee Company; The Lewis Berger Scholarship of £60, open to apprentices, students or craftsmen in the craft of painting and decorating; and the Art Congres Studentship of £50 for practising craftsmen or designers, founded by the late Sir William Cuthbert Quilter.

Valuable prizes ranging from £5 to £52 10s. are also offered as under:

In the Architectural Decoration Section for designs for the decoration of railway compartments; for a metalwork scheme for the vestibule and main entrance of a town hall; fireplaces for gas fires; stained glass window or medallion; leaded lights for departmental store and city restaurant; and an all-tile and faience fireplace.

In the Textile Section for designs for cretonnes; tapestry and furnishing fabrics in cotton, wool and artificial silk; dress materials; hangings; figured and furnishing moquettes and furnishing damask; Wilton, Axminster and Oriental carpets; machine-made lace; and hand embroidery.

In the Furniture Section for designs for dining room table, chairs and sideboard; office desk chair; combination mantels; the interior decoration of a shoe shop; wireless cabinet, sideboard and desk in plywood; panels for baby carriage; and hat and coat hooks.

In the Book Production Section for designs for a title-page; pages of text; head and tail pieces; book illustration; binding case; end papers and jacket.

In the Pottery Section for finished specimens of an origiual decorated design and an example of modelling in fired pottery, as well as a design for a plaque for wall decoration; and in the Glass Section for designs for a modern form of table or pedestal illumination; and for a cocktail glass and shaker.

In the Advertising Section for designs for posters, showcards, cut-outs, lorry bills to advertise the following: a seaside resort, a line of mail steamships, an insurance institution gas, dress prints, bread, suet, chocolates, lubricating oil, petrol, and motor tours, cigarettes, golf balls, an electric wiring system, and the advantages of poster publicity; as well as for designs for Christmas cards, calendars, and covers for a book catalogue and seaside town guide.

The Royal Society of Arts was founded in 1754 for " The Encouragement of the Arts, Manufactures and Commerce of the Country " and it is interesting to remember that it was this Socety's offer of prizes in 1846 for " useful objects calculated to improve general taste " which led to the holding of the Great Exhibition of 1851 and to the commencement of the present school of Art-Workmanship in the British Empire.

NOTICES OF BOOKS.

Catalytic Processes in Applied Chemistry. By T. P. Hilditch, D.Sc., F.I.C. Vol. II of a series of monographs under the Editorship of E. Howard Tripp, Ph.D. Pp. ix + 360. London: Chapman and Hall, 11, Henrietta Street, Covent Garden. Price 16s. net.

One of the difficult aspects of the making of scientific books, which require such a vast amount of research, thought and care, if they are to merit and command a good reading public, is the readiness with which a great part of them become obsolete. Books of real merit like that before us contain facts and truths which hold their own in the future. They may be amplified and supplemented, but will not be displaced. Even works which in part become obsolete quickly, have their uses. They stimulate research and give scientific writers an opportunity of correcting erroneous theories and statements and so contributing something to the great fabric of science. The present work is of the practical kind and seeks with considerable success to enumerate and explain the salient principles of catalytic action and how they are applied in actual practice. While largely specific, the author takes a wide view of some phases of his subject, and the work will be found heplful to students and also those engaged in many industrial processes. The paper, print, and binding leave nothing to be desired.

Forthcoming Events.

ROYAL INSTITUTION.

Tuesday, February 19, at 5.15 p.m.—Prof. J. S. Huxley: " Evolution and the Problem of Species."

Thursday, February 21, at 5.15 p.m.—Prof. A. O. Rankine : "Physics in Relation to Oil Finding."

Friday, February 22, at 9 p.m.—Dr. F. A. Bather : "Lily-Stars of the Sea : How they Fit their Surroundings."

Saturday, February 23, at 3 p.m.—Dr. E. Bullock : "Music in Cathedral and Collegiate Churches."

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London.

SHAW LECTURES—Session 1928-29.

"Thirty Years' Experience of Industrial Maladies." By Sir Thomas Morison Legge, C.B.E., M.D. (Late Senior Medical Inspector of Factories, 1898-1927). Three Lectures on Monday Evenings, February 18, 25, and March 4, at 8 p.m. The lectures will be illustrated by lantern slides.

SYLLABUS.

Lecture I. February 18.—The "Looks" of the People. Advantages of a disengaged eye occasionally in the Factory. A help in determining success or otherwise of Welfare arrangements. Classification of "looks" in women. Results. Difficulty of classify- "looks" in men owing to the interest excited by the absorbing nature of their work. Australian men of a pre-eminently handsome type.

Lecture II. February 25.—Thirty Years' Experience of the Notification of Industrial Diseases. The eleven notifiable diseases and forms of poisoning. Results obtained in disappearance of some, diminution of others and stationary conditions of yet others again. Reasons for this is the remedial measures applied. Dominance of lead poisoning, anthrax and skin cancer.

Lecture III. March.—Twenty Years' Experience of Compensation for Industrial Diseases. The wide net of the Compensation Act. Twenty-eight diseases and forms of poisoning scheduled. Reasons for exclusion of some. Results obtained as shown in the chart. Dominance of miners' maladies. Increase in dermatitis. Increasing importance of silicosis and help given by the action of the South African Government in dealing with it.

Wednesday, February 27, at 8 o'clock.—A. F. Suter : "East Indian Copals and Damars." Dominion and Colonies, Tuesday afternoon, at 4.30 p.m. Dr. J. van der Byl, chairman, South African Iron and Steel industry.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

2,649.—Docking, A.—Removing sulphur from fluids. January 25th.

2,496.—Drescher, H. A. E.—Manufacture of chemical products. January 24th.

2,627.—Fletcher, W. B.—Production of cyanides. January 25th.

2,627.—Fletcher, W. B.—Carrying out chemical reactions. January 25.

2,004.—I. G. Farbenindustrie Akt.-Ges. —Production of ammonia. January 21st.

Specifications Published.

248,685.—Soc. Chmique des Usines du Rhone.—Protection of copper apparatus against corrosion by carboxylic acids.

279,128.—Bomke, H.—Method of preparing hydrogen.

304,441.—Imray, O. Y. (I. G. Farbenindustrie Akt.-Ges). — Manufacture of naphthal ether carboxyamides and aminonaphthal ethers.

304,498.—Johnson, J. Y. (I. G. Farbenindustrie Akt.Ges.)—Production of finely divided sulphur.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

301,364.—Phosphoric acid; soluble phosphates; calcium sulphate.—Kunstdunger-Patent Verwertungs Akt.-Ges., Glarus, Switzerland.

In the production of phosphoric acid or soluble phosphates by leaching raw phosphates and separating the calcium from the solution as calcium sulphate, a temperature of at least 80° C., say 95° C., is employed for the separation, whereby a crystalline form of the sulphate which settles rapidly is obtained. The process may therefore be carried out with concentrated solutions of the reagents. Alkali salts such as potassium or ammonium phosphates, sulphates, nitrates, or chlorides may be present during the separation. The leaching and separa-

tion may both be effected at the high temperature, or the calcium be first brought into solution and be then precipitated at the high temperature, or the calcium sulphate be first precipitated at a lower temperature, and the temperature be then raised above 80° C. Sulphuric acid with or without an alkali sulphate, or nitric or hydrochloric acid with the necessary amount of an alkali sulphate may be used for the leaching. When ammonium sulphate is used as precipitant, the raw phosphate may be mixed with a solution thereof and then the acid be added; when potassium sulphate is used, it is dissolved in the leaching acid.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

CAPORIT.

489,711.—Chemical substances prepared for use in medicine and pharmacy.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. January 30th.

LENIFORME.

497,684.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — Albert Landrin, 135, Boulevard Haussman Paris, France. January 30th.

CAPORIT.

489,785.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. January 30th.

UBROMINT.

498,213.—Chemical substances prepared for use in medicine and pharmacy.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. January 30th.

"EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News*. Price 5s.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager, The Chemical News, *Offices*: Merton House, Salisbury Square. London, E.C.4.

THE CHEMICAL NEWS AND JOURNAL OF INDUSTRIAL SCIENCE.

Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices: Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3593.

MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

TELEPHONES :

Administrative : Central 6521.
Printing Works : Hop 2404.

CONTENTS. PAGE.

Autoxidation Boundary Pressures—Especially that of Phosphorus ... 114
By W. P. Jorissen.

The Hydrogen Molecule and the Electron ... 117
By F. H. Loring.

Some Properties and Transformations of Ortho-Dichloro-4-Nitrobenzene 117
By L. McMaster and A. C. Magill.

Low Temperature Carbonisation Developments ... 118

General Notes ... 119

Proceedings & Notices of Societies :—
- Geological Society ... 121
- The Physical Society ... 122
- Society of Public Analysts ... 122
- The Institution of Mining and Metallurgy ... 123
- London School of Hygiene ... 125
- Royal Microscopical Society ... 125

Notices of Books ... 126

New Patents ... 127

New Trade Marks ... 128

The following figures are significant as definitely establishing the bacteriological efficacy of Lysolats.

Professor Huynen of the State Veterinary University of Brussels recently discovered that a 1% solution of Lysolats (solid form of lysol) in water arrested the developments of bacterial growth in two seconds.

A 1% solution of Lysolats was tried on the following organisms :—

B. Coli	was killed in 40	seconds.
B. Bang	,, ,, ,, ,,	,,
B. Pneumococci	,, ,, ,,	,,
B. Typhosus	,, ,, ,,	,,
B. Staphylococci	,, ,, 50	,,
B. Pyocyaneus	,, ,, ,,	,,

These facts should be of special interest to House Surgeons and Physicians, Hospital Dispensers, Medical Officers of Health, etc. While the cresylic acid content of saponified tarry preparations is of some importance, it will be agreed that germicidal efficiency is the vital factor in the choice of an antiseptic and disinfectant. Lysolats are an antiseptic and disinfectant fulfilling the recognised standards, but with a greater germicidal power than any other known to science.

Members of the Medical Profession are invited to write for free samples of Lysolats to Solidol Chemical Ltd., Ashmead House, Disney Street, London, S.E.1.

Lysolats

PATENT ... LETS)

Lysolats are packed in handy tins containing 40 and 80 tablets at 1/3 and 2/- (respectively) and also in tins of 1,000 tablets.

LIBRARY
TNAU, Coimbatore - 3
000000288

AUTOXIDATION BOUNDARY PRESSURES—ESPECIALLY THAT OF PHOSPHORUS.

By W. P. Jorissen.

(*Continued from Page 97.*)

7. *Influence of other gases.* — Several gases exert an analogous influence on the lower inflammability limit of gases and on the *autoxidation boundary pressure* of phosphorus. Th. Graham[59] remarked already as far back as 1829 : " The action by which certain gases prevent the oxidation of phosphorus is without doubt related to that *by which those gases*, and others, render inexplosive by sparks the explosive mixture of oxygeu and hydrogen."

J. K. Clement (1913)[60] observed that the lower explosion limit for methane and air *increases from* 5.8 to 6.5 per cent. on reducing the oxygen percentage in the air from 20 to 14. The proportion between the concentrations of methane and oxygen had been increased from $\frac{5.8}{20.0}$ to $\frac{6.5}{14.0}$. In accordance with this is the observation of J. Joubert[61] that the phosphorescence boundary pressure of phosphorus at 15—16° was decreased from 670 mm. in the case of oxygen to 505 mm. (of oxygen) in the case of a mixture of equal parts of oxygen and nitrogen. The proportion between the concentrations of phosphorus vapour and oxygen had been increased by the addition of nitrogen from $\frac{0.03}{670}$ to $\frac{0.03}{505}$.

The influence of carbon dioxide is greater in both cases[63]. At 12° the phosphorescence boundary pressure, observed by Jonbert (decreased from 510 mm. for pure oxygen to 261 mm. (of oxygen) for a mixture of 47 per cent. of carbon dioxide and 53 per cent. of oxygen.

The increase of the lower explosion limit of hydrogen, carbon monoxide and methane on substituting nitrogen by carbon dioxide was found by J. Roszkowski[65] to be :

Gas		Lower explosion limit in air vol. %		in mixture of 21 vol. % O_2 and 79% CO_2 vol. %
H_2	...	9.5	...	12.1
CO	...	14.3	...	21.9
CH_4	...	6.0	...	9.0

8. *The experiments of Weiser and Garrison.*—H. B. Weiser and A. Garrison published in 1921[66] three interesting papers on the oxidation and luminescence of phosphorus. In the light of the first four of their experiments they conclude " that solid phosphorus, however pure and dry, will not react with oxygen under pressures which exceed a certain value called the boundary pressure. The results are in accord with those of Jorissen." Experiments 5 and 6 bear upon the glow of oxidising phosphorus. In experiment 7 two glass bulbs, one of 50 cc. and the other of 100 cc. capacity were connected by a 8 mm. stopcock. In the smaller bulb was placed a lump of moist phosphorus after which the apparatus was washed with a stream of oxygen. It was next held between 15° and 20° for more than 24 hours with the stopcock between the bulbs open. This stopcock was then closed and the pressure in the larger bulb reduced slowly while observing carefully in a dark room. No luminescence was obtained, Weiser and Garrison conclude that the absence of phosphorus vapour in the oxygen is proved by this experiment.

However, the *ratio* between the pressure of the phosphorus vapour (if present) and that of the oxygen was not changed during the reducing of the pressure in the larger bulb and so oxidation could not be expected *in my opinion.*

Weiser and Garrison tried to demonstrate as follows that oxygen passed over phosphorus contains no phosphorus vapour[67]. This oxygen " was passed either directly into a tube heated to 75° or was first passed through 10 per cent. sodium hydroxide. A flame was obtained in the heated tube in the first instance but disappeared when the gas was first passed through the alkali." Now by passing the oxygen, which in my opinion contained phosphorus vapour, through sodium hydroxide solution the *ratio* between the pressure of the phosphorus vapour and that of the oxygen changed, oxidation took place in the solution and no phosphorus vapour could be detected afterwards. That phosphorus evaporates in *oxygen and that the vapour pressure is the* same here and in other gases was proved by M. Centnerszwer (1913)[68]. He passed at about 20° a measured volume of different gases : hydrogen, carbon dioxide, coal gas (which contains substances inhibiting the oxidation of phosphorus), air containing vapour of iodobenzene (a powerful inhibitor of the oxidation) and also pure oxygen over small pieces of phosphorus ; in all these cases

the same quantity of phosphorus was removed by the same quantity of gas.

That in all these cases the same quantity of phosphorus was removed can only be explained by supposing that the gas, which was passed over the phosphorus, was saturated with phosphor vapour. (The partial pressure of the phosphorus vapour could be calculated; it was found to be 0.025 mm.)

Centnerszwer, who has studied extensively the action of many substances on the oxidation boundary of phosphorus[69], observed that most of the substances act as negative catalysts. However, diphenylamine and nitrobenzene appeared to be positive catalysts. As Weiser and Garrison suppose the oxidation of phosphorus at a certain pressure of the oxygen to be inhibited by a film of phosphorus trioxide, they thought it probable that the positive catalytic action of the two organic compounds resulted from their action on phosphorus trioxide. Therefore they placed some pure redistilled phosphorus trioxide in a test-tube previously filled with hydrogen and added a few drops of nitrobenzene. "Immediate action was observed which became violent with gentle warming. Similar results were obtained with diphenylamine." However, Weiser and Garrison forgot to try whether the substances which show a negative catalytic influence, act on phosphorus trioxide.

Experiments made by Jorissen and A. Tasman[70] showed that ethyl iodide and dry ethyl alcohol, two of the inhibitors, showed immediate action, comparable with that of nitrobenzene and diphenylamine; other substances such as carbon disulphide, benzene, chloroform, spirit of turpentine, mesityl oxide and amylene dissolved the phosphorus trioxide; again some others did not show any action : iodobenzene, isoamyl chloride, methyl iodide. So this argument of Weiser and Garrison is not convincing. That a protecting film would appear on the phosphorus beneath a certain low pressure and above a certain higher pressure of the oxygen and not between these two, is also improbable. But the best proof that a "film" is not the cause of the appearance of boundary pressures is given by Centnerszwer's experiments with phosphorus solutions[71]. He examined solutions of phosphorus in castor oil, paraffin oil and vaseline oil and observed that the oxidation stopped at a certain pressure of the oxygen; the glow pressures were found to be lower, the lower the partial pressure of the phosphorus above the solution. Moreover, Miss Gilchrist[72] found that shaking the solution does not restore the glow, so that there is no question of a "film." Hans Schmidt[73] also draws the conclusion from his experiments that oxygen in contact with an emulsion of phosphorus and oil of almonds becomes saturated with phosphorus vapour.

9. *N. Semenoff's theory.*—H. L. J. Bäckström, in the third of his interesting papers on "the chain reaction of negative catalysis"[74] remarks that Schönbein[75] drew the conclusion that the property which the different inhibiting vapours possess in common is their power of destroying ozone, which is known to be a promotor of the glow. Miss Gilchrist[72] and Emeléus[74], however, have shown that there are notable exceptions to this rule. "Schönbein's observation suggests, however, that the activity of an inhibitor is due to its oxidizability, and this fact—says Bäckström—can be understood on the chain reaction theory, if it may be assumed that the reaction between excited oxygen molecules and inhibitor molecules, or between excited inhibitor molecules and oxygen molecules, is unable to propagate the reaction chain or, at least, does so less efficiently than the corresponding reactions between phosphorus and oxygen."

N. Semenoff[76] concludes on the strength of the experiments of his pupils and his own researches that phosphorus vapour and oxygen (and also sulphur vapour and oxygen) do not react when the pressure of one of them is smaller than a certain critical pressure. He explains these phenomena as follows : With Arrhenius he supposes that in the case of a reaction $A+B \rightarrow AB$ only the excited molecules A^1 react. When A^1 and B unite an excited molecule AB^1 is formed. This molecule can change into an ordinary one by collision with one of the other molecules, but a collision with a molecule A may lead to the excitation of such a molecule, thus : $AB^1+A \rightarrow AB+A^1$. If we call the probability of this process β, the average number of the molecules A^1 which originate in this way is $\alpha = \beta \frac{a}{a+b}$ (a and b indicating the numbers of molecules A and B in the unity of volume). In general α will be smaller than 1, but if A is diatomic and AB^1 succeeds in splitting A_2 into two excited atoms A^1, α may become greater than 1. But in this case the number of the active particles may increase continually; the reaction will be accelerated automatically and at last it will take place explosively. One

has thus only to suppose that a will be greater than 1 between two oxygen concentrations. Semenoff's theory corroborates thus *my conception that the two oxidation* boundaries of phosphorus may be considered as the lower and upper explosion limits of phosphorus vapour.

The University,

Leiden.

January, 1929.

59 *Ann. Phys.* (Pogg.), 1829, XVII, 375.

60 *Tech. Paper* 43, Bureau of Mines, Washington, 1913.

61 *Thèses*, p. 12.

62 According to M. Centnerszwer, *Z. physik. Chem.*, 1913, LXXXV, 99, the vapour pressure of phosphorus at 20° is about 0.025 mm., here rounded off to 0.03 mm.

63 On the occasion of an investigation about the extinction of flames ([45]), in which the extinguishing power of carbon dioxide (which is greater than that of nitrogen, as Clowes found) was discussed, I could explain the difference by the greater molecular specific heat and the greater conducting power for heat (at high temperatures) of carbon dioxide. The same explanation may be applied, in my opinion, to the results of the experiments with explosive gas mixtures.

64 *Thèses*, p. 42.

65 *J. Gasbel.*, 1890. XXXIII, 496; See also P. Eitner, *ibid.*, 1902, XLV, 222.

66 *J. Phys. Chem.*, 1921, XXV, 61, 349, 473.

67 *l.c.*, p. 379.

68 *Z. physik. Chem.*, 1913, LXXXV, 99.

69 *Z. physik. Chem.*, 1898, XXVI, 1.

70 Not published.

71 *Kosmos*, 1910, XXV, 526, with summary in German; also: *Chem. Zentr.*, 1910, 1022.

72 *Proc. Roy. Soc.*, Edinburgh, 1923, XLIII, 197.

73 *Physik. Z.*, 1913, XIV, 120.

74 *Meddel. Vetenskapsakad. Nobelinst.*, 1927, VI, No. 16.

75 *J. Chem. Soc.*, 1926, 1836.

76 *Z. Physik*, 1927, XLVI, 109; 1928, XLVIII 571; *Z. physik. Chem. B*, 1928, I, 192.

THE HYDROGEN MOLECULE AND THE ELECTRON.

By F. H. Loring.

Since the electron is much larger than the proton whilst possessing wave characteristics, why not consider the electron as a conical vortex which attaches itself to its positive counterpart. The *counterpart*, however, is in every possible way the converse of the electron, and this is, probably, as it should be.

Figs. 1 and 2 here show the idea in diagram, the latter representing H_2.

Such a structure as here shown could expand and contract and suffer other changes in configuration even to the extent of developing along its surface waves.

Perhaps electrons move through conductors very much as a tornado does in traversing the earth's surface.

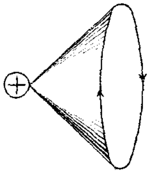


FIG. 1.

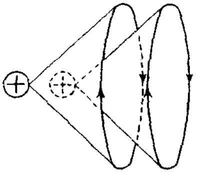


FIG. 2.

DIATOMACEOUS EARTH.

Diatomite has hitherto been mined only in very small quantities in Nova Scotia, but it is likely before very long to become a product of some importance in Canada. Recently a deposit of large magnitude, stated to be the richest in eastern Canada, has been under development at Digby Neck. Diatomaceous earth has for many years been extracted in small quantities by the Oxford Tripoli Sales Company in Colchester County, and the Company has also installed a new plant at East New Annand where they have located four large bogs containing a big tonnage of diatomite.

SOME PROPERTIES AND TRANSFORMATIONS OF ORTHO-DICHLORO-4-NITROBENZENE.*

By L. McMaster and A. C. Magill.

Beilstein and Kurbatoff found that 4-nitro-*o*-dichlorobenzene formed in two modifications when *o*-dichlorobenzene was treated with fuming nitric acid. They describe a semi-fluid mixture from which the solid part settles out and can be crystallised from alcohol in long needles of m.p. 43° and b.p. of 255-256°. Holleman has studied the nitration of the dichlorobenzenes and found that when the ortho compound is dropped into nitric acid cooled to 0 or 30° the 1,2-dichloro-4-nitrobenzene is the principal product along with small amounts of isomers. His work on its physical constants agrees with those of Beilstein and Kurbatoff but he makes no mention of a liquid form.

In connection with some work to prepare *o*-chloro-*p*-nitraniline, we found that the nitration of o-dichlorobenzene always gave us a mixture of the liquid and solid forms of *o*-chloro-4-nitrobenzene. Since Beilstein and Kurbatoff give no information regarding any changes of the one form into the other and since the literature records no other nitro-*o*-dichlorobenzenes as liquids we decided to make a study of some of the properties and transformations of *o*-dichloro-4-nitrobenzene.

Experimental.

Purification and Nitration of o-Dichlorobenzene.—The *o*-dichlorobenzene used in this work was prepared from the commercial material supplied us by the Monsanto Chemical Works. It was first distilled to remove any mono- and trichlorobenzene, the fraction between 165 and 200° being retained. One litre of this fraction was then cooled to −15° so that any of the para compound present would crystallise out and could be filtered off. The filtrate was distilled, the fraction boiling between 174 and 180° being collected and cooled to −15°. This procedure was repeated and the fraction boiling between 177 and 180° was found to be free from the para isomer by sulphonating a portion of the liquid with fuming sulphuric acid and pouring the mixture into water. By this process the ortho only is sulphonated. Any *p* - dichlorobenzene present would be unchanged and separate out in the water. If the aqueous solution of the *o*-dichlorobenzenesulphonic acid is then steam distilled, the *o*-dichlorobenzene will pass over. After drying and distilling, it was water white and had a sp. gr. of 1.299 at 20°.

In order to purify the material further it was nitrated and distilled with steam. *p*-Dichlorobenzene does not readily nitrate and, if present, can be be blown out with steam. The nitro compound was then reduced with tin and hydrochloric acid. The reduced product was not removed from the mixture but was diazotised at once and boiled with water and an excess of caustic soda. The o-dichlorobenzene separated out, was drawn off, dried and distilled. In order to replace the diazo group by hydrogen we found that alcohol and other reducing agents were not necessary. The crystallising point of the compound was found to be −17.5°. The "International Critical Tables" give is as −17.6°, whereas the Monsanto Chemical Works have recently found it to be −16.7° on a sample prepared by a different method than just described.

One hundred and twenty-five cc. of the pure *o*-dichlorobenzene was nitrated, using 200 cc. of sulphuric acid of sp. gr. 1.84 and 175 cc. of nitric acid of sp. gr. 1.42. Nitration at 60° was easily effected in two hours with stirring. The nitro compound was separated, washed a number of times with water, dried over calcium chloride and distilled, the fraction between 254 and 257° being collected; yield, 95 per cent. of the theoretical. Nitration of 125 cc. of the *o*-dichlorobenzene was also accomplished in two hours at 60° by using 370 cc. of commercial mixed acid containing 57.3 per cent. of sulphuric acid and 38 per cent. of nitric acid; yield, 94 per cent. of the theoretical. A mixture of the liquid and solid forms was obtained.

Some Properties of o-Dichloro-4-Nitrobenzene.—The solid portion obtained above, when crystallised from alcohol or carbon tetrachloride, melts at 43 . When *o*-dichloro-4-nitrobenzene is kept at 15° the liquid form changes entirely to the solid form as long yellow needles of m.p. 43°. This would seem to indicate that no other isomer is present in the liquid form. We recognised the fact that a small amount of the *o*-dichloro-4-nitrobenzene (m. p. 62°) might be present. If, however, the material is kept at 25°, all of it changes to the liquid modification mentioned by Beilstein, the solid phase disappearing. Twenty g. portions of the material were kept for periods of

* Abstracted from the *Journal of the American Chemical Society*, 1928, L, 3038.

eight hours each at various temperatures between 15 and 25°. It was found that an appreciable amount of the liquid was present at 17°. At 22° the material appeared to be half liquid and half solid. At 24° a very small quantity of the solid remained. The crystals obtained weighed 10.1 g. Apparently the solid and liquid are present in equal quantities at this temperature. When the crystals were allowed to stand at 22° they gradually changed until about 50 per cent. of liquid was present. When the liquid was allowed to stand at this same temperature about 50 per cent. of crystals formed. Of course the solubility of the solid form in the liquid is to be considered, but a number of experiments gave the same results. When the solid material was crystallised from alcohol or carbon tetrachloride, the crystals obtained did not change to the liquid modification. If some of the other o-dichloronitrobenzenes were liquids, it is quite possible that the liquid form of the 4-nitro compound would be a mixture of the solid form and the liquid dichloronitrobenzene, but such is not the case.

Action of Alcoholic Potash on o-*Dichloro-4-Nitrobenzene.*—There is no mention in the literature of the action of alcoholic potash on o - dichloro - 4 - nitrobenzene. Twenty g. of the liquid-solid mixture was refluxed with 40 g. of potassium hydroxide in 200 cc. of ethyl alcohol. When the reaction mixture reached 80°, a vigorous reaction set in and within five minutes was complete. The solution turned red and a dark red solid precipitated out. The solid, which proved to be 3,3′,4,4′-tetrachloro-azoxybenzene, was filtered off and recrystallised from carbon disulphide; 14 g. of crystals of m.p. 139° was obtained. The filtrate was poured into water and acidified with hydrochloric acid. A black, tarry mass formed. Thas was filtered off, warmed with caustic soda to dissolve the phenol and again filtered. The filtrate, when acidified with hydrochloric acid, had a very pronounced phenol odour. The liquid was extracted with ether and 0.5 g. of 2-chloro-4-nitrophenol, melting at 110°, was obtained. The residue obtained by heating the tarry mass with caustic soda was extracted with ether, from which was obtained 1.8 g. of 3,4-dichloro-aniline of m.p. 72°. The literature records 71.5°.

3,3′,4,4′-Tetrachloro-azoxybenzene was prepared by G. M. Kraay by the oxidation in air of 3,4-dichloro-phenylhydroxylamine. He found the melting point to be 139-139.5°

Summary.

o-*Dichloro-4-nitrobenzene* was found to exist in a liquid and a solid modification, the two existing in approximately equal quantities at 22°.

Alcoholic potash on the compound gives mainly 3,3′,4,4′-tetrachloro-azoxybenzene and small quantities of 3,4-dichloro-aniline and 2-chloro-4-nitrophenol.

Four ethers of the compound were prepared, three of them for the first time. The 2-chloro-4-nitro-anisole had been previously prepared by a different method. Some of their properties are described. Three of these were reduced, diazotized and coupled with β-naphthol, giving red and purple dyes.

LOW TEMPERATURE CARBONISATION DEVELOPMENTS.

Important Commercial Plants in Four Countries.

By A Well-Known Engineer.

The rapid progress now being made in connection with more scientific methods for coal utilisation is well indicated by a contract that has now been placed by the Lukens Steel Co., of Coatesville, Pennsylvania, for the erection of a "K.S.G." low temperature carbonisation plant of 6 standard retorts with a throughput of about 500 tons of highly bituminous coal per 24 hours. Equally important is that a "K.S.G." plant with a capacity of 550 tons of coal per week is now approaching completion at the works of the South Metropolitan Gas Company in London. This latter has been in course of erection for a number of months, consisting of one standard "K.S.G." retort having a normal throughput of 80 tons of coal per 24 hours, with complete cooling, condensing and by-product plant, as well as producer gas generator, to utilise coke breeze or other low grade material for supplying gas to heat the setting and generate the power necessary. In this way all the rich gas evolved by the carbonisation is left available for towns' gas supply.

As we have previously described, the "K.S.G." process consists in the use of a standard retort in the shape of a rotary slightly inclined, steel cylinder, 76 feet long, by 10 feet diameter, having an inner cylinder of 5 feet 8 inches diameter, the average throughput being 60-85 tons of coal per 24 hours. The speed is one revolution in 90 seconds, while the travel of the charge first through one cylinder and then the other

in turn is approximately $2\frac{1}{2}$ hours, the maximum temperature being 925-1,025° F., with extensive heating on the usual lines by means of gas firing in a firebrick setting, but including special arrangements as regards circulation and control of the heating gases.

The yield follows the usual practice, that is from one ton of 25-35 per cent. volatile coal there is obtained 3,500-5,000 cubic feet of rich gas at 800 B.Th.U. per cubic foot, 3 gallons of light oil scrubbed from the gas, 15-20 gallons of low temperature tar, and 14 cwt. smokeless fuel with 10-20 per cent. volatile matter.

The main claim of the "K.S.G." process it will be remembered is the direct conversion of bituminous coal dust and smalls, with mechanically continuous operation and therefore high throughput and low working costs, into a dense, hard, free-burning, high-grade smokeless fuel in large pieces, equal or superior to the best quality graded lump coal. No preliminary or auxiliary treatment such as briquetting, mechanical compression of the plastic charge, or compression by confining the swelling material in small intermittent retorts is necessary.

Also the original plant at Essen, running since 1924, is to be extended by the addition of two more retorts, at the Mines de Lens in France there is an installation of one standard retort on the way, and the New Jersey plant of 8 retorts, that is 650 tons a day, will be ready for running by next March.

GENERAL NOTES.

BOARD OF TRADE ANNOUNCEMENT.

Dyestuffs Advisory Licensing Committee.

The Board of Trade, on the nomination of the Association of British Chemical Manufacturers, have appointed Mr. Ernest Hickson of Messrs. Hickson and Partners, Ltd., Castleford, Yorks, to be a member of the Dyestuffs Advisory Licensing Committee, in place of the late Mr. W. H. Dawson.

OUR OVERSEAS TRADE IN JANUARY.

Imports into this country during January reached a greater value than in any month since January, 1926, when prices were much higher. The value of British exports was also greater than in any month since November, 1927. Re-exports were larger than in December but smaller than in January, 1928.

FIRE DAMP EXPLOSION RESEARCH.

As the result of investigations carried out by the Safety in Mines Research Board, means have been devised to allow for complete or partial release of the pressure developed by firedamp explosion within closed vessels, such as the casings of electric switchgear, and at the same time to ensure that the flame of the explosion shall not pass from the casing to the atmosphere outside. Experiments by Beyling in Germany have, however, suggested that when the casings are divided into intercommunicating compartments by partitions, the ignition of an explosive mixture in one compartment might result in considerably enhanced pressure in the other.

An account of an investigation into this possibility is given in a paper entitled "Firedamp Explosions Within Closed Vessels: 'Pressure Piling.'" The research has shown that if an explosion of firedamp and air is allowed to propagate from a casing of comparatively large volume through a narrow opening into a casing of comparatively small volume, pressures considerably above the normal are very rapidly produced within the smaller casing, and that in these conditions even weak mixtures of firedamp and air can produce violent explosions. Care should therefore be exercised in the design of casings to avoid inter-connected compartments.

CANADA'S COAL TRADE IN 1927.

According to the Final Report on the Coal Statistics for Canada, the coal consumption increased during 1927 by nearly two million tons, the gain being wholly in respect of fuel used for industrial purposes. The 1927 coal output of 17,426,861 tons was a record for the industry in Canada. At the same time exports were more than during any other year sinwce 1923. Exports were nominal at 1,100,000 tons. Nova Scotia, New Brunswick and British Columbia each produced more coal than in 1926. Alberta and Saskatchewan dropped behind their totals for the previous year. Once again, Nova Scotia took the lead as Canada's greatest producer of coal; Alberta was second; British Columbia third; and Saskatchewan and New Brunswick followed in order.

A feature of the year's coal import business was the importation of nearly one

million tons of coal from Great Britain. Never before had so great a tonnage been brought to Canada from that source. While there does not seem to be anything particularly significant about the figures for bituminous coal imports from various sources, a study of the anthracite importations reveals the fact that the average quantity imported in each of the last six years amounts to about four million tons, and that, further, the records for the past two years show a very definite shifting of business in this field. In 1926 imports of anthracite from the United States totalled 3,883,242 tons, and from Great Britain 272,170 tons, which with 87,520 tons from other countries, made a total of 4,242,932 tons. In 1927 the distribution showed 3,265,411 tons from the United States, 788,235 tons from Great Britain and 9,973 tons from other countries, making a total of 4,063,619 tons. Importations from Great Britain in 1927 evidently displaced about half-a-million tons of anthracite formerly purchased in the United States.

St. Lawrence Coal Market—Record Shipments from Nova Scotia.

During the season of navigation which closed recently, bituminous coal shipments from Nova Scotia to Montreal reached a new record, 1,659,206 tons being shipped between the last days of April and the end of November. This represents an increase of 65,000 tons over the previous peak figure which was in 1927. This quantity of coal, brought to Montreal in 181 shipments, represents average cargoes of 9,111 tons. Last season 1,593,907 tons of bituminous coal from Sydney, N.S., were landed in Montreal from 178 ships, the next highest figure having been that for 1926.

The respective amounts of Nova Scotia coal landed at Montreal since 1922 are as under :—

1928	...	1,659,206	tons
1927	...	1,593,907	,,
1926	...	1,429,194	,,
1925	...	568,086	,,
1924	...	1,267,227	,,
1923	...	1,080,485	,,
1922	...	1,216,485	,,

DISTRIBUTION OF OUR TRADE IN 1928.

Imports into the United Kingdom from British Empire sources last year accounted for 27.02 per cent. of the value of the total from all countries, as compared with 26.87 in 1927 and 24.87 in 1913. Exports of British produce to Empire customers amounted to 41.95 per cent. of the whole, as against 42.56 in 1927 and 37.18 in 1913.

AMERICAN INFLUENCE IN ITALIAN INDUSTRY.

The latest European industry to submit to the peaceful penetration of American industrial methods and financial aid is Italy's leading heavy machinery-making concern, the Breda company. After studying and adopting the technique of United States works, the Breda concern is now looking to America for capital to finance its development, and has arranged for a $5,000,000 loan to be issued shortly by Dillon Read & Co., the New York bankers.

So well has the Italian company learnt from American technical methods that it recently beat its teachers, as well as German and British competitors, in tendering for locomotive contracts for the Egyptian and South African railways. It has gone to the limit of modernity in erecting its own airport, and manufactures aeroplanes which play a large part in the Italian Government's aviation schemes.

The Rt. Hon. Lord Melchett, P.C., F.R.S., D.Sc., Chairman, the Hon. Henry Mond, Deputy Chairman, Mr. Robert Mond, Mr. D. Owen Evans, Mr. John P. Bicknell and Mr. Grant B. Shipley, Directors of the Mond Nickel Company Limited, and Sir Harry McGowan were elected Directors of the International Nickel Company of Canada, Limited, at a recent meeting of the Board of that Company in pursuance with the Agreement between the two Companies which was confirmed by acceptance of the offer to exchange shares on the 28 January, 1929.

The Advisory Committee mentioned in the circular to the shareholders has been constituted :—

Lord Melchett who was elected Chairman, Lord Weir, who was elected Deputy-Chairman, and Sir Harry McGowan.

The other members of the Committee are :— Mr. Charles Hayden, Mr. Robert C. Stanley, Mr. James A. Richardson, and Mr. John W. McConnell.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY.

The following papers were read on January 23 :—

The South Wales End-Moraine. By PROF. JOHN KAYE CHARLESWORTH, D.Sc., Ph.D., M.R.I.A., F.G.S.

The Irish-Sea Ice stood over Cardigan Bay at the period of the maximum advance of the Newer Drift period, and ponded back the natural drainage of Northern Pembrokeshire and Southern Cardiganshire to form a chain of extra-glacial lakes connected by marginal streams. This drainage, except at an early stage failed to escape across the main watershed into the Bristol Channel, and was led along the ice-edge into Cardigan Bay. The largest lake occupied the valley of the Teifi, and was 34 miles long.

The end-moraine of the Newer Drift passes across Eastern and Southern Wales. In Northern Pembrokeshire and Southern Cardiganshire, where the moraine is rarely conspicuous and often absent over considerable stretches, it was laid down along the edge of the Irish Sea Ice, contemporaneously with the operation of the highest marginal channels of these areas.

Farther east, the moraine is practically continuous, and represents the marginal product of the local Welsh Ice which was centred in the mountains of Central Wales, the Carmarthenshire Vans, the Brecon Beacons, the Black Mountains, and the mountains of Radnor Forest. This ice flowed beyond the outlets of the great valleys of the east to form the valley-glaciers of the Severn, Clun, Lugg, Arrow, Wye, and Usk, and extended southwards on to the coastal plain of Glamorgan as the Glamorgan Piedmont Glacier and the Swansea Bay Piedmont Glacier. The end-moraine is disposed in loops around these glaciers, and passes beneath or near the following places : Tregaron, Swansea, Kyle, Cowbridge, Cardiff, Risca, Usk, Abergavenny, Pandy, Hereford, Wellington, Leominster, Craven Arms, and Montgomery.

This Newer Drift, which probably marks the culmination of the cold of the Glacial Period in Britain, is shown to be of early Magdalenian age by the collective evidence of the Upper Palæolithic implements of Britain. It was preceded by the "Aurignacean Oscilation," the minimum extent of which can be estimated from the distribution of the remains of the Pleistocene mammalia in the drifts and caves of the North of England.

The raised beach of the southern part of the British Isles is earlier than the Older Drift.

The Glacial Geology of the Derbyshire Dome and the Western Slopes of the Southern Pennines. By ALBERT JOWETT, D.Sc., F.G.S., AND PROF. JOHN KAYE CHARLESWORTH, D.Sc., Ph.D., M.R.I.A., F.G.S

The Derbyshire Dome of the Southern Pennines was overridden at the period of maximum glaciation by ice from the north and north-west. This is shown by the occurrence of fairly extensive patches of true Boulder Clay, ranging up to 20 feet in thickness, by the wide distribution of erratics of Lake District and Galloway rocks over the dome and along its valleys, and by a southward carry of the local rocks, such as Carboniferous Limesone (dolomitic and non-dolomitic, cherty and non-cherty varieties), Millstone Grit, and Toadstone.

The upper limit of the Galloway and Lake District erratics follows the outer flanks of the South-Western Pennines at an average height of about 1250 feet above sea-level, decreasing slightly southwards in the direction of flow.

The ice-recession from this position was associated with a copious marginal drainage, which eroded a well-developed suite of channels linking a number of big extra-glacial lakes in the valleys of the Western Pennines. These waters escaped at the same successive stages : (1) by the Walsden Gorge into the Todmorden valley and the Humber drainage; (2) by Dove Holes into the Wye, Derwent, and Trent basins; (3) into the Trent drainage by its tributaries north and west of Stoke-upon-Trent and by the Rudyard Gorge, north of Leek; and (4) by the Market Drayton Gap into the Severn and the Bristol Channel.

The following papers were read on February 6 :—

The Horizons of Bryozoa (Polyzoa) in the Upper Eocene Deposits of Hampshire. By E. ST. JOHN BURTON, F.L.S., F.G.S.

The Upper Estuarine Series of Yorkshire. By MAURICE BLACK, B.A., F.G.S.

THE PHYSICAL SOCIETY.

The following papers were read on Friday February 8:—

The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measurement of High Vacua. By L. F. Stanley, A.R.C.S., B.Sc.

The low pressure gauge described consists of a manometer and a compensator, the one identical with the other, placed in the opposite arms of a Callendar-Griffiths bridge; each consists, essentially, of a loop of 10 cm. of platinum wire, of 0.001 inch diameter, together with a compensating loop of 2 cm. of the same wire. The symmetry of the circuit makes errors due to thermoelectric effects very small. Investigations have been carried out to ascertain how the sensitivity of the instrument depended upon:

1. The diameter of the gauge.
2. The temperature of the wire.
3. The temperature of the external walls.
4. The nature of the material of the external walls.

The gauge constructed follows variations of pressure with considerable rapidity, and its range of measurement is from 2×10^{-3}mm. to 4×10^{-6}mm. approximately.

The Photographic Measurement of the Relative Intensities of the $L\alpha_1$, $L\alpha_2$, $L\alpha_3$ *Lines of Silver.* By H. C. Webster, M.Sc., University of Melbourne.

The relative advantages of the ionisation, Geiger counter, and photographic methods of measuring X-ray line intensities are discussed. The factors governing the density of a Rontgen spectroscopic photographic image are discussed. Previous work has shown the validity of the Bunsen-Roscoe reciprocity law for X-rays. A vacuum spectrograph and Moll microphotometer were used and the film calibrated by varying the exposure time. Corrections were made for the overlapping of the lines. The results obtained were: $L\alpha_1 : L\alpha_2$, 100 : 12.0; $L\alpha_1 : L_3\alpha$, from 100 : 4.6 to 100 : 7.8, according to the tube voltage. A less accurate value of $L\alpha_1 : L\beta_1$ is 100 : 40.

Spark Satellites of the $L\alpha$ *Lines of Silver.* By H. C. Webster, M.Sc.

Using a relative method, the wavelengths of four spark satellites of silver $L\alpha$ were measured, the results being 4134.7, 4130.5, 4125.6, 4119.0 x.u.

A Demonstration of a new instrument for the rapid and accurate determinations of the specific gravities of solid substances was given by Mr. W. A. Benton, Head of Research Department, Messrs. W. and T. Avery, Ltd.

SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting of the Society was held on February 6, the President, Mr. Edward Hinks, being in the chair.

Certificates were read for the first time in favour of Frank Atkins, Edmund Baron Bennion, M.Sc., A.I.C., John Haslam, M.Sc., A.I.C., Stanley Gordon Kendrick, B.Sc., A.I.C., Bryn Jones, B.Sc., A.I.C., John Upton Lewin, B.Sc., A.I.C., Leslie John Walker.

Certificates were read for the second time in favour of William Bennett Adam, M.A., A.I.C., Alfred Louis Bacharach, B.A., F.I.C., Andrew Dargie, B.Sc., A.I.C., and Wadie J. Itayim.

The following were elected Members of the Society:—Edwin Herbert Bunce, A.I.C., Frederick O'Brien, M.Sc., F.I.C., William Macro Seaber, B.Sc., F.I.C., John Graham Sherratt, B.Sc., F.I.C.

The following papers were read and discussed:—

The Fatty Acids and Component Glycerides of Some New Zealand Butters. By T. P. Hilditch, D.Sc., F.I.C., and Eveline E. Jones, M.Sc.

The procedure consisted in oxidising the butter fat by means of permanganate under conditions in which all unsaturated components were transformed into acidic products, whilst glycerides containing only saturated fatty acids remained unaltered. These fatty acids were recovered and their composition determined by separating the lower fatty acids as completely as possible by distillation and refractionation, whilst the non-volatile acids were separated into groups by the lead salt and ether method followed by conversion of the acids from the soluble and insoluble lead salts into methyl esters which were quantitatively fractionated by distillation at low pressure.

The approximate composition of the butters examined was calculated to be as follows:— Mixed fatty saturated glycerides, about 30; mixed mono-oleo-disaturated glycerides, about 36; and mixed di-oleo-monosaturated glycerides, about 34 per cent.

A New Test for Boric Acid and Borates. By A. Scott Dodd, B.Sc., F.I.C.

The pink colouration produced by the addition of mannitol and methyl red, or sofnol indicator No. 1 to a neutral solution is characteristic of boric acid, a distinct reaction being obtained with as little as 0.2 mgrm. The only substances causing any

interference with the distinctness of the reaction are phosphates, arsenates, chromates and tungstates, and in their presence it is difficult to ascertain the exact point of neutrality. Tunstates differ from all the other substances examined in giving a reddish-pink colour similar to that given by boric acid, but the reaction takes place much more slowly than with boric acid.

The Determination of Small Quantities of Beryllium in Rocks. By B. E. Dixon, M.Sc., A.I.C.

The chief obstacle to the accurate determination of small quantities of beryllium in silicate rocks is the difficulty of separating it from titanium. This difficulty has been overcome by the use of *p*-chloroaniline, which will precipitate titanium completely, without causing any precipitation of beryllium. A method embodying this principle has been devised for the analysis of a silicate rock.

THE INSTITUTION OF MINING AND METALLURGY.

(*Continued from Page* 107.)

Third Ordinary General Meeting (38th Session) held on Thursday, December 20, 1928, at the Rooms of the Geological Society, Burlington House, Piccadilly, London, W.1., Professor S. J. Truscott, President, in the Chair.

Discussion on—

The Importance of Recovered or "Secondary Tin." By J. B. Richardson, Associate.

Mr. H. K. Picard said that this paper dealt with aspects of a subject upon which it was difficult to get information in this country, as evidenced by the fact that the author had to go to the United States for essential statistics which were there more readily obtainable.

The speaker recently had occasion to ascertain the consumption in this country of a certain tin preparation; on application to the Board of Trade the only information obtainable was that this particular product was included with many others under the head of "Miscellaneous," wherefore the desired particulars were not available.

Professor Lawn had referred to the treatment of low-grade ores; the author mentioned ores of 80 per cent. tin content and said that these were not ordinarily acceptable to tin smelters; doubtless the author knew that ores well below 30 per cent. of tin were marketable though the returning charges were very high. He had noted with interest that the returning charges for certan by-products were of the same order as those charged for low-grade ores of similar content, and this charge was approximately similar for a range of products of varying composition.

The author estimated that, during a period of four years, the percentage of recovered tin in this country was 28.7. Though not questioning the author's figures, he (the speaker) had been interested in endeavouring to arrive at an estimate for a particular year (1926) upon data given in Quin's " Metal Handbook."

U.K. Tin (ingots) imported ......13,819 tons
,, ,, ,, exported ......27,419 ,,
,, Smelter Production ......40,000 ,,

Nett amount of metal (after deducting exports) 26,400 tons. Tin-plate exported, 400,000 at, say, 2 per cent. tin = 8,000 tons; this left a balance of 18,400 tons. Other exports (he had no data as to this) might be taken at, say, 3,400 tons, which would mean a home consumption of 15,000 tons; if 5,200 tons be recovered as " secondary " tin, the percentage would be 34.6 per cent. If the " other exports " exceeded 3,400 tons the percentage figure would naturally be higher.

As to the method of treatment, the information and flow-sheets given were valuable. He would refer to a small point mentioned; the author said that, even with 6 per cent. of pitch, a good briquette could be obtained with most fines. To the speaker this seemed to be a high proportion; if a harder pitch were employed he believed that this percentage could be reduced and would prove cheaper in result although a patch of increased price was used.

He was interested in the reference to Goldschmidt's de-tinning process, particularly as to the statement that this process was first introduced by Higgins in 1854. His own impression was that Goldschmidt was the first to insist on the necessity for perfectly dry chlorine if satisfactory results were to be obtained.

He thanked the author for bringing this paper before the Institution, and considered it to be one of the most useful metallurgical papers presented for some time. He also appreciated Professor Lawn's view that the mining engineer might not be expected to be greatly interested in the recovery of secondary tin; nevertheless the metallurgist certainly was interested, since provided he got his tin it was a matter of indifference whether it were derived from ore or from already worked products.

Mr. Baliol Scott said that probably he was the most ignorant person in the room as regarded the technical matters raised in the paper. There were, however, one or two small points which occurred to him. He would not suggest that the author's figures were incorrect, but he would like to know how he arrived at his figure of 1,000 tons of contained tin per annum for silk-weighting and similar uses. One was always the victims of rumours in these cases. He could recall the assurances given about 1907-8 as to the very rapid increase in the use of satin for dress fabrics in this connection. On subsequent occasions when he had asked people who were supposed to be in touch with consumption for this purpose they had said that fashions changed materially; but at the time of which he was speaking there was a heavy demand for silks of a heavy and "swishy" character, and the virtue of tin weighting appeared to be that it gave the desired "*frou frou*" to the skirts. Nowadays such skirts had disappeared, and there was not the same demand. It was a very small point, and he mentioned it only by way of illustration, but it showed how difficult it was for the ordinary person to judge how far the experiences given for the various trades were up to date and how far they were based on past conditions. Had the consumption of tin in dress material increased in anything like the same way that the wearing of silk had increased?

One other very small point. The author mentioned somewhere in his paper that the present tonnage of tin wasted annually was enormous. One might look at the question very much as one regarded the existence of low-grade ores of which it was said that there were such large bodies in Cornwall and elsewhere. These at present ,in the American phraseology, were not "ores," they were only "minerals." He did not know how far the tonnage which the author was anxious to see recovered fell within the category of being commercially recoverable. This depended to a large extent on the local price. When one looked at the proportion which the author noted as recovered in the United States—about 46 per cent.—one would not assume that the amount which he might describe as practically wasted was very great. The point was merely put forward on the basis of such knowledge as an outsider could have of what it actually cost to recover.

It had been stated that the smelters and others treating these classes of material would not furnish information. They said, naturally, that they were watching each other, and while the information which they themselves afforded might not in itself disclose anything, it might be followed by developments elsewhere from which there could be pieced together some useful information to competitors, although to the ordinary man it might appear to be a puzzle without a solution. He could not help sympathising with this point of view, and he felt it unlikely that these people would be induced to take any other view of the case.

Mr. Richardson, the author, in reply to the point made by the last speaker about the disappearance of the silk skirt, pointed out that the wearing of silk stockings was now universal, and this was one of the reasons for the increase in the use of tin in textiles. In the paper published by Buttfield in New York, to which he had referred in his opening remarks, it was stated that several thousand tons of tin were used in silk weighting. That was partially in corroboration of the figure of 1,000 tons in this country mentioned in the paper that evening. As to how much was recoverable, Buttfield stated that about one-third of the total tin employed in weighting silk passed on with the wash waters and was not absorbed by the silk, but he claimed to recover an almost theoretical amount by his improved process, indicating that improvements were being made in the existing processes for the recovery of residual tin to an extent which made is possible to predict that in the future more than 46 per cent. of the consumption would be recovered.

Mr. L. E. B. Pearse congratulated the author on his description of facts relating to what was more or less a closed industry. But when the author said that he was going to eliminate a great deal of waste, a question arose in the speaker's mind. The smelting methods might be improved, but as for the waste, this was another matter. The author stated that there were many hundreds of small men up and down the country who were recovering material which, the speaker rather gathered, Mr. Richardson would prefer to go into his own smelter. These small men were probably recovering and liquidating the material and turning it over immediately to use. If this material went to the smelter it would mean that it was kept about for a long time, and meanwhile there was interest on capital to pay. The author's own figures did not seem to prove that there was very much to be done in the way of getting more tin from

municipal collecting, having regard to the United States' de-tinning statistics. Old tins and such material were very widely distributed over the world; largely, he supposed, as containers of the foodstuffs which members in the tropics were unfortunately obliged to eat. There were not many places, however, where one could set out collecting tins at a profit, and even the municipalities, he judged, did not find it a very remunerative process.

With regard to de-tinning of these tins and such-like material, he wished to ask whether the profit was made from the tin recovery entirely, or whether it was not largely made from the sale of the underlying metal to steel-makers?

Mr. Richardson, in replying to some points on the discussion, said that he could not inform Mr. Pearse what were the profits on de-tinning; but he was aware that some of the de-tinning people, instead of turning out metallic tin, treated copper wire and sold it as tinned copper wire. With reference to the question of "used tinplate," his own view was that municipalities and others were not very efficient in the collection of this material. Glasgow was, he understood, an example to the contrary, and had instituted a method by which a large amount of metallic refuse was salvaged. It had even been suggested that separate receptacles be kept by the housekeeper, one for such refuse as could be burned, and the other for more permanent material such as metals. A number of municipalities put the work of sorting refuse out to contract; the work was done by men on some kind of bonus system, and they picked out the materials which were of value. He did not see why such a system should not be explored and perfected, so that all over the country a lot of valuable material (including tin) should be recovered. Municipalities did not always work for profits—this was said with a glance at such enterprises as tramways — and therefore were not perhaps particularly interested in getting the best return out of refuse, but if they could be interested there was a great deal of work they might undertake in this connection.

ESTATE OF THE LATE SECRETARY OF THE ROYAL SOCIETY OF ARTS.

Sir Henry Trueman Wood, of Bourne End, Bucks, for 38 years secretary of the Royal Society of Arts, who died on January 7 last, aged 88, left estate of the value of £47,210, with net personalty £46,943.

LONDON SCHOOL OF HYGIENE.

Examination Results.

The following result of the examination for the 85th session at the London School of Hygiene and Tropical Medicine (Division of Tropical Medicine and Hygiene) is announced :—

Passed with Distinction—S. Batchelor (winner of "Duncan" Medal), T. C. Backhouse, J. Bryant, L. S. Chatterji, R. S. F. Henuessey, M. Hewitson, W. S. Nealor, A. J. W. Wilkins.

Passed—C. M. Africa, K. P. Anklesaria, E. A. Aslett, F. C. K. Austin, D. C. Bell, P. S. Bell, D. D. Bhargava, J. S. Brown, J. A. Carman, I. E. Chandler, A. D. Charters, N. Chilton, H. L. Chopra, J. C. Chukerbuti, A. H. Craig, M. Das, T. J. Davidson, G. E. Dodds, A. N. Duggal, A. L. Goddard, J. G. Green, H. E. Hargreaves, E. Haworth, W. Hunter, H. Joomye, N. Kamchorn, C. Libert, L. S. Liu, S. I. McMillen, A. Mearns, G. M. M. Menzies, G. W. Milledge, C. E. G. Nunns, N. M. Rane, S. L. Rikhye, J. S. Robinson, S. F. Russell, I. A. Senanayeke, E. H. Stahly, R. Stanford, E. M. Turner, F. B. Turner, O. R. Unger, A. E. S. Whatron, E. W. Whitcomb, C. D. Williams, D. B. Wilson.

ROYAL MICROSCOPICAL SOCIETY.

Wednesday, 20 February.

The following were elected Fellows :—Robert O. Ducker, William D. Grier, Frank J. M. Robertson.

Papers read and discussed :—

Some Effects of Radium on Cell Division in vitro. By Dr. R. G. Canti and F. G. Spear.

Some Effects of X-rays on Cell Division in vitro. By S. F. Cox.

An Effect of Low Temperature on Cell Division in vitro. By F. G. Spear.

The following Demonstrations were also given :—

"The Effect of a Heavy Dose of X-Rays on Living Cells as shown by the Dark-Ground Method." By S. F. Cox.

"Demonstration of Cell Division in the Living Tissues Cultivated *in vitro*." By Dr. R. G. Canti.

(Apparatus provided by the Strangeways Research Laoratory.) There were a Series of Stained Preparations showing :—

(a) The Effect of Radium on Cell Division —Dr. R. G. Canti.

(b) The Effect of X-rays on Cell Division —Mr. S. F. Cox.

(c) The Effect of Low Temperature on Cell Division—Mr. F. G. Spear.

NEW MEMBERS OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

At a general meeting of the Royal Institute of British Architects held on February 4, the following members were elected :—

Fellows—H. J. Axten, O. H. Collins, M.A., P.A.S.I., R. F. Dodd, W. Eaton, F. W. Hagell, R. W. Horn, F. J. Humphry, F. W. Knight, D. N. Martin-Kaye, E. Meredith, A. D. Parham, H. J. Rowse, E. F. R. Sample, G. Sanville, O. F. Savege, M.C., L. A. D. Shiner, P.A.S.I., W. H. Thompson, M.C., F. D. Ward, E. C. M. Willmott, D. W. Galloway, L. H. Keay, A. S. Killby, M.M., F. W. H. Lee, E. H. Major, C. A. Masey, J. J. Robinson, B. C. S. Underhill, F. White, J. D. Cairns, L. D. Penman, E. Sage, and J. E. Yerbury.

Associates—E. C. P. Allen, H. A. H. Bull, H. R. C. Cornford, B.A. (Cantab.), A. C. Cotton, E. B. Cumine, N. A. Fellowes, B.Arch. (McGill), E. R. B. Hariss, W. M. Hutchison, Irene J. Macfadyen, K. R. Mackenzie, B.Arch. (Liverpool), H. T. Parry, S. R. Pierce, L. H. B. Roberts, Captain E. L. Thompson, and E. C. Turner.

Hon. Fellows—Mr. A. Neville Chamberlain, M.P., and Lord Peel.

Hon. Associates—A. M. Daniel, J. Penoyre, C.B.E., M.A., Sir Philip Colville Smith, C.V.O., and A. H. Thompson, M.A., Hon.D.Litt., F.B.A., F.S.A.

NOTICES OF BOOKS.

Technik der Emulsionen. By Dr. Otto Lange. Pp. viii + 391. Berlin : Julius Springer. 1929. Price Rm. 28.

In the field of Emulsions the volume by Clayton (The Theory of Emulsions) dealt with the subject as far as it had progressed to the time of its publication and Dr. Lange has continued on the lines of the English ovlume, bringing the subject up to date and dealing more particularly with the technique of preparing and examining emulsions.

The author first describes the various physico-chemical phenomena presented by surface tension effects, film formation and the de-emulsifying influences. The general section deals with the preparation and stabilisation of emulsions with special reference to those of technical and industrial importance, *e.g.*, soaps, water glass, lipoids, saponins, etc. Then follow sections on the fatty and mineral oils, emulsions in food preparations, those in the rubber, paints and varnishes, cellulose, leather, cement, artificial stone and dyeing industries.

Undoubtedly the book is an important addition to the literature of applied science.

A Comprehensive Treatise on Organic and Theoretical Chemistry. By J. W. Mellor, D.Sc., F.R.S.. Vol. IX., As, Sb, Bi, V, Cb, Ta. Pp. xii + 968, with 161 diagrams. Price 63s. net. London : Longmans, Green & Co., Ld., 39, Paternoster Row, E.C.4.

The present is volume IX of the great work on Inorganic Chemistry by J. W. Mellor, a learned and painstaking author, whose works are deservedly esteemed by all chemists and scientific workers who desire to have at hand an exhaustive and authentic work on inorganic chemistry. The Treatise is to be completed in XIII volumes, and we may be sure that all those who are the fortunate possessors of the IX volumes published up to the present will eagerly await the publication of the other four volumes. Anyone who secures the complete set of XIII volumes will be the fortunate possessor of what might be considered a valuable and an exhaustive library on Inorganic Chemistry. Those students of chemistry and others who have neglected to secure the previous volumes should hasten to order a copy of the present volume, which is complete in itself, as regards those subjects which are so exhaustively dealt with by the author. The volume consists of six chapters on Arsenic, Antimony, Bismuth, Vanadaum, Columbium and Tantalum, to which close upon 1,000 pages are devoted, which will give some idea of the completeness of the information given. The notes and references as well as the Index are exhaustive, the work is produced in the high-class style for which Longmans, Green and Co. are justly famous, and should occupy a prominent place in every important scientific library.

PUBLICATIONS RECEIVED.

U.S. Department of Commerce.

Binder's Board, Simplified Practice Recommendation. R 81-28.

Hollow Metal Single-Acting Swing Doors, Frames and Trim. Simplified Practice Recommendation. R82-28. 5 cents each.

The Cambridge University Press have just issued their 1929 *Catalogue* of the Books published by them. These include many important chemical and scientific textbooks as well as a wide range of general, applied science, literary, and educational volumes. The *Catalogue* is prefaced by a short account of the history of Cambridge Printing.

PUBLICATIONS RECEIVED.

Annual Report of the Director of the U.S. Bureau of Standards. Pp. 46. Price 5 cents.

1927 *Report* (fifty-first) of the Connecticut Agricultural Experiment Station. Pp. 821 + xxvi.

Forthcoming Events.

ROYAL INSTITUTION.

Friday, February 22, at 9 p.m.—Dr. F. A. Bather: "Lily-Stars of the Sea: How they Fit their Surroundings."

Saturday, February 23, at 3 p.m.—Dr. E. Bullock: "Music in Cathedral and Collegiate Churches."

Tuesday, February 26, at 5.15 p.m.—Prof. J. S. Huxley: "Evolution and the Problem of Species."

Thursday, February 28, at 5.15 p.m.—Prof. A. O. Rankine: "Physics in Relation to Oil Finding."

Friday, March 1, at 9 p.m.—Sir Robert Robertson: "Infra-Red Spectra."

Saturday, March 2, at 3 p.m.—Sir Ernest Rutherford: "Molecular Motions in Rarefied Gases."

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London.

SHAW LECTURES—Session 1928-29.

"Thirty Years' Experience of Industrial Maladies." By Sir Thomas Morison Legge, C.B.E., M.D. (Late Senior Medical Inspector of Factories, 1898-1927). Two Lectures on Monday Evenings, February 25 and March 4, at 8 p.m. The lectures will be illustrated by lantern slides.

SYLLABUS.

Lecture II. February 25.—Thirty Years' Experience of the Notification of Industrial Diseases. The eleven notifiable diseases and forms of poisoning. Results obtained in disappearance of some, diminution of others and stationary conditions of yet others again. Reasons for this is the remedial measures applied. Dominance of lead poisoning, anthrax and skin cancer.

Lecture III. March.—Twenty Years' Experience of Compensation for Industrial Diseases. The wide net of the Compensation Act. Twenty-eight diseases and forms of poisoning scheduled. Reasons for exclusion of some. Results obtained as shown in the chart. Dominance of miners' maladies. Increase in dermatitis. Increasing importance of silicosis and help given by the action of the South African Government in dealing with it.

Wednesday, February 27, at 8 o'clock.—A. F. Suter: "East Indian Copars and Damars." Dominion and Colonies, Tues-Byl, chairman, South African Iron and Steel Industry.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

3,024.—Akt.-Ges fur Stickstoffedunger.—Manufacture of acetic acid. January 29th.

3,312.—Bromig, K., and Deutsche Gold-und-Silber-Scheideanstalt Vorm. Roessler.—Obtaining glutamic acid. January 31st.

3,156.—Deutsche Gold-und-Silber-Scheideanstalt Vorm. Roessler.—Preparing oxygen-evolving preparations. January 30th.

3,055.—Tocco, L.—Activating chemical reactions. January 29th.

3,376.—Wheeler, T. S.—Method of absorbing hydrogen cyanide from gases. February 1st.

Specifications Published.

304,809.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges).—Production of green hydrated chromium-oxide.

292,991.—Soc. Chimique Des Usines du Rhone.—Process for the manufacture of potassium manganate.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

302,208.—Separating mixtures of hydrocarbons of low boiling point.—Johnson, J. Y., 47, Lincoln's Inn Fields, London.

Mixtures of gaseous or low boiling hydrocarbons with or without other organic substances of low boiling point are separated into their components by subjecting them after liquefaction to fractional distillation under elevated pressure. The separation is obtained by gradually releasing the pressure while maintaining the temperature or

by gradually raising the temperature while maintaining the pressure. Cyclohexane is decomposed by passing its vapour through a quartz tube filled with calcium aluminate at about 600° C. as described in Specification 297,898 and a mixture is obtained containing 28 parts by weight of ethylene, 14 parts propylene, 4 parts butylene and 40 parts butadiene. The mixture is liquefied by compression and introduced into a still connected with a pressure fractionating column several metres in height. The pressure is reduced to 15 atmospheres and ethylene alone is liberated. Heat is then applied and propylene distills over at 25° C. under a pressure of 12 atmospheres while butadiene is separated at 45° C. under 5 atmospheres pressure, and finally butylene at 52° C.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

VITROCOL.

495,471.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives. — The J. M. Newton Vitreo and Colloid (1928) Limited, Africa House, Kingsway, London, W.C.2. February 6th.

GORUN.

496,893.—All goods in class 3 which includes chemical substances prepared for use in medicine and pharmacy.—Hirsch Gregor Jacubson, 38, Fritschestrasse, Charlottenburg, Berlin, Germany. February 6th.

SETORAN.

497,018.—Chemical substances being wetting out agents for silk and artificial silk fabrics in the course of manufacture.—The Hexoran Company, Limited, 68, Major Street, Manchester. February 6th.

" EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News.* Price 5s.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager, The Chemical News, *Offices* : Merton House, Salisbury Square. London, E.C.4.

THE CHEMICAL NEWS AND JOURNAL OF INDUSTRIAL SCIENCE.

Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered througn any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,

18, Rue de Bretagne ASNIÈRES (Seine) FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3594.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

A Statistical Periodic Table 129
By H. H. Stephenson.

Comenius—The Mediæval Educationalist 131

Vitamin Researches in Japan 131

Refrigeration in Nature 132
By Franklin Kidd, M.A., D.Sc.

The Application of Chemistry in Modern Farming 134

General Notes 136

Proceedings & Notices of Societies :—

The Royal Society 139

The Optical Society 140

The Physical Society 141

Royal Institution 141

Pharmaceutical Society 142

Institute of Physics 142

Forthcoming Events 143

New Patents 143

New Trade Marks 144

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

A STATISTICAL PERIODIC TABLE.

By H. H. STEPHENSON.

An attempt is here made to construct a periodic table of the chemical elements on the two concepts of atomic weight and atomic number by purely statistical methods without any preliminary reference to the chemical properties of the elements. If such a periodic table were found, and the system were quite discordant with the known properties of elements, it might be argued that atomic weights as we know them now are not representative of the true atomic weights, but are merely random samples of isotopes, or, alternatively, that increase of atomic weight does not in itself confer change in chemical behaviour. On the other hand, if a statistical system were found to contain several remarkable instances of chemical similarity in its groupings, then it might be worthy of further study to ascertain the cause of the dissimarities that occur in it, and to see what positions it assigns to the transitional elements and the long line of rare-earth elements.

The method here adopted is to arrange the elements in the order of their atomic number, and thence to calculate the *percentage increase of atomic weight* of each element over its predecessor. There is a negative increase in some well-known instances: A-K, Co-Ni, Te-I; these are accepted as minus numbers and studied as such in the statistical series.

When the numbers so obtained are arranged in columns of 3, 4, 5, etc., up to 30, it is found that the sums of the vertical columns are only in regular order (denoting periodicity) for columns of 3 and columns of 6. Thus, for 3 columns the sums are 425.4, 196.1, 130.3, which are in order, but for 4 columns the sums are 381.2, 150.0, 99.7, 111.3, the fourth column being greater than the third, thereby denoting a lack of periodicity of 4.

The elements may therefore be arranged in columns of 6 (the higher of the only two numbers at choice) to form a table which is periodic statistically with regard to percentage increase of atomic weight. The first element, H, is left out, since it has no predecessor from which to calculate increase, and the last element, U, is left over, unless it is the first of another line of undiscovered elements.

Table I gives the elements in columns of 6; Table II the statistical figures on which the system is founded.

TABLE I.

STATISTICAL PERIODIC TABLE.

	I.	II.	III.	IV.	V.	VI.	
H→	He	Li	Be	B	C	N	
	O	F	Ne	Na	Mg	Al	
	Si	P	S	Cl	A	K	
	Ca	Sc	Ti	V	Cr	Mn	
	Fe	Co	Ni	Cu	Zn	Ga	
	Ge	As	Se	Br	Kr	Rb	
	Sr	Yt	Zr	Nb	Mo	[43]	
	Ru	Rh	Pd	Ag	Cd	In	
	Sn	Sb	Te	I	Xe	Cs	
	Ba	La	Ce	Pr	Nd	[61]	
	Sm	Eu	Gd	Tb	Dy	Ho	
	Er	Tm	Yb	Lu	Hf	Ta	
	W	[75]	Os	Iy	Pt	Au	
	Hg	Tl	Pb	Bi	[84]	[85]	
	Rn	[87]	Ra	[89]	Th	[91]	→U

TABLE II.

PERCENTAGE INCREASE OF ATOMIC WEIGHT.

	I.	II.	III.	IV.	V.	VI.	
H→	296.8	73.5	30.0	20.0	11.0	16.7	
	14.2	18.7	6.3	13.9	5.7	10.9	
	4.1	10.6	3.3	10.6	12.6	-2.0	
	2.5	12.5	6.2	6.4	2.1	5.6	
	1.7	5.5	-0.4	8.3	2.8	6.6	
	4.1	3.2	5.7	0.9	3.7	3.0	
	2.6	1.6	2.5	2.1	3.1	[3.0]	
	[2.9]	1.2	3.7	1.1	4.2	2.1	
	3.4	2.6	4.7	-0.4	2.6	2.0	
	3.4	1.1	1.0	0.5	2.4	[2.1]	
	[2.1]	1.0	3.4	1.2	2.1	1.6	
	2.6	1.0	2.5	0.8	2.1	1.6	
	1.4	[2.1]	[1.6]	1.2	1.1	1.1	
	1.7	1.9	1.4	0.9	[2.0]	[2.0]	
	[2.0]	[0.9]	[0.9]	[1.4]	[1.4]	[1.3]	→ [1.3]
	345.5	137.4	72.8	68.9	58.9	56.6	

PROPERTIES OF THE STATISTICAL PERIODIC TABLE.

When we examine the table, which as yet is purely mathematical, for its chemical properties, as in the modern versions of the Mendelejeff system, we find some remarkable chemical relationships.

Each column begins and ends with related elements, the first with He-Rn, the second with Li-eka Cs, the third with Be-Ra, the fourth with B-[89], the fifth with C-Th, and the sixth with N-[91].

Each column contains two sets of triads: the first Si, Ge, Sn, and Ca, Sr, Ba; the second P, As, Sb, and Sc, Yt, La; the third S, Se, Te, and Ti, Zr, Ce; the fourth Cl, Br, I, and V, Nb, (Pr?), Bi; the fifth Mg, Zn, Cd, and A, Kr, Xe; and the sixth Al, Ga, In, and K, Rb, Cs. And many of these triads have another member of the same Mendelejeff family associated with them, as Hg with Ca, Sr, Ba; Tl with Sc, Yt, La; Au with K, Rb, Cs.

Thus the statistical table has some well-defined chemical relationships. Its study may be of interest for its dissimilarities and for the positions which it assigns to the transitional and rare-earth elements.

COMENIUS—THE MEDIÆVAL EDUCATIONALIST.

John Amos Comenius, or Komensky, was in many ways an important pioneer in the sphere of scientific education. He undoubtedly assisted in stimulating research along the right directions and in making orderly thought and reasoning take the place of haphazard enquiry and hasty conclusion.

The tercentenary of his exile from Bohemia was celebrated towards the end of last year by scientific gatherings in Prague, Czechoslovakia, and the Bohemian Academy of Science has issued a volume giving an account of Comenius' life and work and the President of the Republic, Prof. T. G. Masaryk, has written a Preface in which he says :—

" I cannot take it upon myself to discuss the great teacher of our nation and of mankind in his role of pedagogue hut will confine myself to a few words about Comenius as philosopher and politician. Even in this connection he shows himself as the father of modern pedagogics, he regarded educational methods as part, and indeed the principal medium, of the general culture both of the nation and of mankind as a whole.

" Comenius perceived, from the events that were taking place throughout the world, that a new age was dawning—a renewal of the whole earth as he called it. A new education, a new culture was, first and foremost, and indeed exclusively, to serve its rebirth. Plato in his Ideal State had already outlined the education of the masses and this, too, was the aim of Comenius. And is not education to-day everywhere undertaken by the State? . . . .

" This new education could only be successfully carried through on the basis of a new conception, a new philosophy. Hence spring Comenius' efforts in the direction of Pansophy. The sense of Pansophy may be briefly elucidated by the contemporary aim at what in England was called synthetic philosophy. . . ."

Comenius' connection with England arose from his wanderings in Poland, Germany and Holland. In 1641 he came to London to lay his views before certain Members of Parliament and before the leaders of Science and Education. The outbreak of the Civil War distracted attention from his schemes and as no tangible results seemed likely, Comenius returned to Holland. His ideas were, however, not entirely forgotten for in 1662 the Royal Society was founded and doubtless those of its original members who had heard his teachings bore them in mind when they framed the scope and objects which the Society has in view.

Comenius' chief interests in Science were Astronomy (although he did not accept the Copernican Theory), and Geography. His main work was really devoted to the cause of education. Many of his writings are concerned with the teaching of languages and useful knowledge. As a leader of the persecuted Bohemian (Moravian) Brethren he was obliged to write a number of tracts appealing especially for religious toleration. He was not interested in dogma but resented the intolerance shown after 1620 by the conquerors of his country. He was driven into exile in 1627, and died in Amsterdam in 1670.

VITAMIN RESEARCHES IN JAPAN.

Vitamin researches started very early in Japan. In 1908 Dr. U. Suzuki conducted several experiments on the anti-beriberi principle contained in rice-bran, and in 1912 he extracted from rice-bran a certain substance which contained a very active anti-beriberi principle and the gave it the name " Oryzanin." This was about the same year in which Funk (December, 1911) studied the Oriental disease, beriberi, and found an accessory food substance, and gave it the name " Vitamin."

Suzuki's " Oryzanin " is now manufactured on an industrial scale by the Sankyo Co., and widely used for the curative purpose of beriberi disease, which prevails largely in Japan. It is also used in research laboratories for feeding tests of animals as a source of Vitamin B. Recently, Dr. T. Takahashi made a Vitamin B preparation from brewery yeast, and put it on sale under the trade name " Vitafortin."

Now let us turn our attention to Vitamin A. Concerning this, an elaborate research was carried out by the late K. Takahashi. He attempted to isolate Vitamin A from cod-liver oil and succeeded in obtaining an extraordinary active substance of crystalline nature from the unsaponifiable matter of cod-liver oil. He thoroughly examined both the chemical and physiological nature of this newly-isolated substance and named it " Biosterin " (or " Biosterol ") on account of the fact that it is absolutely essential to life, and has general properties of sterols. According to Dr. M. Miura's experiment, the growth-promoting action of biosterin is 1,000 times as great as the same weight of the original cod-liver oil, or 34,000

times as great as the same weight of ordinary butter.

At present, a Vitamin A preparation is being made on an industrial scale from cod-liver oil, and sold in the market under the trade name "Vitamin A." Among these manufacturers, the Rikwagaku Kogyo Co., and the Sankyo Co. are to be noted. The commercial Vitamin A preparation contains both the growth promoting accessory—Vitamin A, and the anti-rachitic accessory—Vitamin D, and its growth-promoting and curative power is about 25 times as great as cod-liver oil, or several hundred times as great as ordinary butter.

Quite recently, Dr. Ueno has found that the liver oil of "ishinagi" fish (*Stereolepis ischinagi*, Hilgendorf) contains an extraordinary amount of Vitamin A, and it is reported that its potency is several hundred times as high as that of cod-liver oil, that is to say, the liver oil of "ishinagi" fish is equally potent as the commercial Vitamin A preparation above cited.

Researches on other vitamins, *i.e.*, Vitamin C, Vitamin D or irradiated ergosterin, and another unknown accessory which concerns the reproduction of young, are now being energetically carried on.

Among those who are concerned in vitamin researches, the following are to be noted:—Dr. U. Suzuki, Dr. M. Miura, Miss M. Tsujimura (all at the Institute of Physical and Chemical Research), Dr. Fujimaki (Imperial Institute of Nutrition), Dr. Shimazono (clinical researcher in Tokyo Imperial University), and Dr. S. Ueno (Osaka Higher Technical School).

R. Tomoda.

—*Japanese Society of Chemical Industry.*

REFRIGERATION IN NATURE.

By Franklin Kidd, M.A., D.Sc.

Before the Royal Society of Arts—Extract from Cantor Lecture.

An interesting introduction to the study of low temperature effects upon plants and plant produce is to be found in the great field laboratory of nature.

Let us consider the striking phenomenon of winter hardiness in plants. The broad features of the phenomenon are simple. Plant life as a whole possesses no heat regulatory mechanism or means of locomotion and is at the mercy of the temperature conditions of its environment. We find certain plants existing at temperatures many degrees below the freezing point of water. The leaves of evergreens during the severe conditions of a northern winter in Canada or Norway survive many degrees of frost. On the other hand there are many plants which cannot withstand freezing temperatures at all. Such forms are especially common among species adapted to growth in hot countries. We may, therefore, set ourselves the problem of ascertaining what special properties are associated with the power of resistant forms to survive and preserve their living protoplasm intact when ice is formed in the tissue, or alternatively, what it is associated with ice formation which so easily kills non-resistant forms.

Allied to this phenomenon of the capacity or lack of capacity to tolerate freezing temperatures is the interesting fact that many plants cannot tolerate for long low temperatures, even when they are above the freezing point.

The Economic Significance of Winter Hardiness.

Owing to its greater economic significance the subject of winter hardiness or frost tolerance has received up to the present the most attention.

To producers the winter hardiness or cold tolerance of their trees and crops is often a matter of critical importance. Let me take two examples, cereal crops and fruit trees. In Canada and the United States they speak of test winters. Such were those ending the years 1872, 1884, 1898, 1917 in the North West, and in addition to the above also 1876, 1895 and 1903 in the East. During these test winters damage to fruit trees was often widespread and disastrous. After the severe 1906 winter a survey of 950 orchards in Maine showed 24,000 trees killed outright out of a total of 443,000, that is, about 6 per cent. As many more again were injured.

The growers of the two staple crops, lucerne or alfalfa and wheat, the one of fundamental importance to the livestock industry and the other for the supply of bread, are faced in the northern parts of the U.S.A. and Canada with the same problem and hazard as the fruit growers—the problem of obtaining winter hardiness in their crops and the hazard of loss by winter killing. Winter killing is practically the only factor which limits the growing of wheat in the northern regions. It is not surprising, therefore, that a considerable amount of attention has been paid, especially in U.S.A. and Canada, both to the theoretical and practical aspects of this subject of winter hardiness.

FROST TOLERANCE ARTIFICALLY INDUCED.

As soon as we begin to examine carefully in particular cases the reaction of various plants to the natural refrigeration of nature a number of generalisations come to light. We find in the first place that many plants which are immediately killed after even the mildest exposure to frost when such exposure overtakes them suddenly, as when removed from a warm greenhouse, can nevertheless withstand quite severe freezing conditions if they are "educated" to them by stages through intermediate temperatures. This is the process which growers term hardening. Withholding water from the roots for a period produces similar results. A single experiment out of many carried out by Harvey in 1918 may be quoted, especially with reference to the effect of low temperature in inducing cold tolerance. It is sufficiently striking. Harvey took two lots of young cabbage plants, grown in a warm bed. One lot he placed at a low temperature, 3° C., or about 38° F. The other he kept at 18° C., or about 70° F. Then at intervâls he took specimens from each of these lots and exposed them to extremely severe freezing conditions for half-an hour. The result was clear cut. The plants removed directly from the warmth to freezing conditions were without exception killed. Of the plants which had been allowed to harden during 5 days a 38° F., all survived, though exposed to the same degree of frost for the same length of time, and although in this exposure they had been frozen stiff.

AGE AND FROST TOLERANCE.

Again on the whole it may be said that the younger he tissue, the more able it is to survive exposure to low temperatures and the formation of ice. Perhaps I may remind you here that plants as distinct from animals are perennially young. They possess growing points, masses of undifferentiated cells rich in protoplasm, which, by continued multiplication and subsequent differentiation, build up what is in essence an infinite series of repeated parts, each part partially and sometimes wholly, after a certain stage, independent of the series as a whole. In any plant, therefore, there may thus be at the same time tissues and cells at the two extremes of the life cycle; some essentially as youthful as the products of the first division of a fertilised egg cell; others on the point of death, wonderfully modified in appearance and form after a life of stressful experience.

The younger leaves of evergreens are more cold resistant than the older. The natural life of the leaves of the evergreens, as you know extends to three or four years, so that these leaves afford convenient material for studying the problem of age and cold resistance in plants. The great cold resistance of the embryonic cambium tissue as compared with the wood or bark in dormant trees has been frequently notes and accounts for the recovery of trees after severe injury.

The influence of frost tolerance may be obscured owing to differences in the state of dormancy in tissues of different age.

DORMANCY AND FROST TOLERANCE.

Another generalisation of interest and significance is that dormant, as opposed to active tissues, are far more hardy. The rest period in plants, in which young as well as old tissues equally participate, is a very interesting phenomenon. It has been studied most in the case of woody plants whose natural habitat is in the temperate zones, and in the case of seeds. Recently in the Missouri Agricultural Experimental Station some 300 species of woody plants were submitted to very thorough investigation with regard to this point. The phenomenon is briefly this. As Autumn advances there ensues a slowing down of cell activity. The causes which induce this rest ing stage are not very well understood, but, in general, experiment and observation point to two main conditions which are effective, (1) drying, that is to say the withholding or removal of water and (2) exposure to temperatures which are low but above the freezeing point. One may note that the two conditions which are broadly associated with the induction of the dormant or resting state are identical with the treatments, well known to growers, which are used to harden plants when they are transferred from hot-house conditions to the open and to the liability of exposure to frost.

There is, however, much evidence of an inherent periodicity in plants, in alternation between rest and activity. Equatorial regions with uniform temperatures present the phenomenon of plants, some in the resting stage while others are in growth. Sometimes, even on the same tree, one branch may be resting, while another is in active growth.

When once the dormant condition is established, it is not broken merely by establishing artificial spring conditions, for example, by bringing cut branches or whole plants into the greenhouse.

In the Missouri investigation 300 species of woody plants were found to have a definite rest period, and it was, moreover, clearly shown that the length, onset and intensity of the rest period were (as judged by the intensity of measures needed to break it) definite racial characters distinguishing varieties and species.

Numerous observations appear to establish definitely the main thesis that tissues are better able to withstand freezing temperatures when in a dormant state.

Some experiments of Chandler and of Strausbaugh are interesting. Chandler estimated first the relative cold tolerance of a number of peach varieties by studying the percentage of buds killed in the severe winter of 1905-6. In the following year he took shoots in the winter and estimated the number of buds which could be forced into development at different dates. There appears from his results a rough parallelism between the stability of the resting state in different varieties, and the degree of resistance to severe winter conditions.

Summary of Factors Determining Frost Injury in Plants.

In these few examples we have touched briefly on a few of the outstanding factors which may enter into the question of injury, or the occurrence of irreversible changes when living tissues are frozen. There is the speed of cooling, affecting the manner in which ice is formed; the temperature reached and the water-holding power of the cell systems, affecting the amount of ice formed; the influence of increased salt concentration upon the colloidal state of the protoplasm; the time of exposure, affecting the extent of slow changes in the dessicated colloids. To these variants must undoubtedly be added the specific nature of the colloidal constituents, and of the salts of different tissues. Such then are the possibilities which are to be subjected to detailed quantitative investigation when any specific case of freezing injury or more broadly, of non-reversibility in freezing-thawing cycles are in question.

Our study of plants in the laboratory of Nature has led us to see that though low temperature and freezing may appear the obivous method of retarding changes in stored food products, closer consideration has indicated that there are many complications both in living and post-mortem systems.

THE APPLICATION OF CHEMISTRY IN MODERN FARMING.

Under the auspices of the Manchester and District Section of the Institute of Chemistry recently, Sir E. J. Russell, Director of the Rothamsted Experimental Station, gave a lecture on the above subject, before a joint meeting of the Section of the Institute, with the Manchester Sections of the Society of Chemical Industry and the Society of Dyers and Colourists, and the Manchester Literary and Philosophical Society. Mr. L. Guy Radcliffe, chairman of the Manchester Section of the Institute, presided.

Sir John Russell said that the first great triumph of chemistry in modern farming was the introduction of artificial fertilisers, notably calcium superphosphate, sulphate of ammonia, nitrate of soda, and potassium salts. Since the war, there had been the added achievement of synthetic nitrogenous fertilisers. Artificial fertilisers had added greatly to the productiveness of soils all over the world, had given large crops of cereals, potatoes, sugar beets, grass, etc., and had caused a large increase in the production of milk and meat. Superphosphate played an important part in the agricultural development of Australia: indeed, it was not too much to say that without artificial fertilisers the earth to-day could not feed all its population.

Fertilisers not only increased the crop, but altered its composition and habit of growth. Fertilisers were also used to influence quality, and especially to help the plant to adapt itself to different weather conditions. For example, superphosphate encouraged root development and therefore helped the young plant to become established and to send its roots down into the moist subsoil—a very valuable thing in dry seasons. Sulphate and muriate of potash increased the efficiency of the leaf and so helped the plant in a sunless season. This explained their importance in Northern Europe. In regions where the climate was fairly regular from season to season this method of adjusting the crop to the climate by means of fertilisers was likely to be very useful when it was better understood, and in the uncertain climate of England it had already proved useful in levelling up good and bad seasons, especially for the growth of fodder crops.

The effect on quality was less easy to analyse. Nitrogenous fertilisers tended to increase the amount of protein in the crop, which might enhance their feeding value,

but might detract from other values, *e.g.*, increased nitrogen-content in barley would usually lower the brewing quality of the grain. On the other hand, an increased nitrogen-content of wheat was associated in a general way with improved baking properties.

These good effects of fertilisers along with the improvements in seed, crop varieties and farm machinery, said Dr. Russell, had enabled British farmers to attain high yields in good years, and to avoid the disasters such as used periodically to occur, as when in 1879 the wheat crop almost completely failed : there was now always a crop whatever the season. The problem of increased production per acre was solved sufficiently for to-day's needs, and efforts were now directed to lowering the costs of production by increasing efficiency and lowering waste and loss.

In recent years, he continued, there had been an increase in the number of plant diseases. Every country had always had a few; and nowadays, with more rapid transport, diseases were liable to be carried from one country to another. Further, under cultivation, plants were more liable to disease than in the wild state. Wild wheat on the hills of Palestine and Transjordania did not get rust; but, cultivated on the experimental farm, it did. The most destructive crop disease in the history of mankind had been the ordinary potato blight (*Phytophera infestans*). This was a native of South America, and it never reached Europe until steamships began to make the journey from South America in such short time that they could carry vegetable products. About 1840 it invaded Ireland and swept the country with all the vigour of a new pest, destroying the potato crop on which the peasants lived, reducing them to starvation; so that thousands died in the terrible famine that followed. For forty years Ireland was never free. Once the disease appeared, the farmer was helpless; nothing could be done. Of all the tyrants Ireland ever had, the potato disease was the worst. It cost thousands of lives, untold suffering and misery, and millions of money; but, after forty years, a remedy was found in Bordeaux mixture, and the blight has never caused serious trouble since. Following on this had come a host of chemical fungicides and insecticides, and there seemed considerable outlet for coal-tar derivatives in this direction. One of the chloro-cresols had been found at Rothamsted to have special insecticidal value.

An important set of applications of chemistry to agriculture had arisen out of the improved knowledge of the chemistry of the soil. The greatest part of the soil was composed of minerals and their derivatives, and of these by far the most important was clay. Its agricultural properties were now explained by recognising that the clay of normal soils was a calcium compound of a very complex alumino-silicic acid. As in other compounds, the calcium could be replaced either by hydrogen or by another metal. Replacement by hydrogen was effected by washing the clay with rain water; it gave an acid clay of sticky unpleasant nature familiar to all cultivators in cold, wet regions. Replacement by sodium occurred whenever sodium salts were brought into contact with the clay—a common occurrence in irrigated areas; the sodium clay was sticky and very different to work, and the result might be highly unfortunate. In either case the best remedy was to get back to the calcium clay by adding calcium carbonate to an acid clay or calcium sulphate to an alkaline one, but this process was often difficult and expensive and a cheaper method was very desirable.

In the general advance of agricultural science it was often difficult to pick out what had been done by chemists and what by other workers. Chemists were first in the field, but biologists, physicists, and, nowadays, mathematicians were playing an increasingly important part, and their work was so interblended that discrimination was not always easy.

The achievements of science in agriculture were perhaps best summed up by comparing the prediction of Sir William Crookes in 1898 with the accomplishments of agriculture to-day. Speaking with a full knowledge of science as it then was, Sir William Crookes [Founder of the *Chemical News*] predicted that the world in 1931 would require 90 million tons of wheat to feed its population, but that this represented the utmost that the wheat growers of the world could do; afterwards the world would be faced with starvation. The accuracy of his forecast in regard to consumption showed how carefully he had made his calculation. As he predicted, the world required in 1928 about 90 to 100 million tons of wheat, but science had advanced so much as to upset altogether his calculations about the possible production. The quantity of 90 millions which he thought was the limit had been much exceeded even in 1911, and could be considerably exceeded to-day if it were

wanted. The fear of world starvation had gone, and the achievements of science were only at their beginning.

—Abstracted from the *Journal of the Institute of Chemistry*.

GENERAL NOTES.

OVERSEAS TRADE.

His Majesty's Consul-General at San Francisco (Mr. Gerald Campbell, C.M.G.) reports that an important company in that city is anxious to get into touch with United Kingdom suppliers of coal tar and coal tar products.

Firms desirous of offering goods of British manufacture can obtain further particulars of this enquiry upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 5099 should be quoted .

TENDER FOR CATTLE DIPPING MATERIAL.

Tenders are invited for the supply of "cattle dipping material" to the Swaziland Government during the year from April, 1929, to March, 1930.

Approximately 40 tons (80,000 lbs.) of arsenite of soda containing 80 per cent. arsenious oxide, and suitable for cattle dipping purposes; or a quantity, equivalent to 40 tons of arsenits of soda, of any other cattle dipping material.

In the case of the latter, the amount of tick destroying ingredients must be stated.

Tenders must state price at port or station f.o.r.

Sealed tenders, superscribed. "Tender for Cattle Dipping Materials," must be addressed to Mr. W. A. Elder, Principal Veterinary Officer, Mbabane, Swaziland, and must be in his hands by 12 o'clock noon on Wednesday, the 20th day of March, 1929.

CANADA'S COPPER PRODUCTION.

Canada's large 1928 production of 192,000,000 pounds of copper is likely to be quadrupled within the next three years, and by 1931 the Dominion should be producing at the rate of 750,000,000 pounds, or 375,000 short tons. The world production in 1931 is expected to be 4,000,000,000 pounds.

The Sudbury nickel-copper mines will be the chief providers of the increase and may be a production of 300,000,000 pounds in the district by 1931. Apart from the International Nickel Company's mines, production is likely from the Treadwell, Yukon, Falconbridge Nickel and Sudbury Basin mines, together with several smaller ones.

In Quebec, the Noranda smelter is now producing at a rate of 50,000,000 pounds of copper annually, which production is expected to be doubled by the end of this year, a tital of 155,000,000 pounds of copper annually from the Rolyn field being expected within the next three years.

Manitoba mines are nearing the production stage, the plant at the Flin Flon mine being in process of erection. At the Sherritt-Gordon, construction is expected early next winter, and an output of 100,000,000 lbs. of copper from Manitoba is counted upon in 1931.

Mines in other parts of Canada should add 50,000,000 pounds of copper annually to the total production of the Dominion.

Further expansion of production will depend upon new discoveries both in old and in new mines. As the Sudbury field, for instance, daily gives evidence of remarkable wealth, the estimate of 300,000,000 pounds for Ontario may prove by 1931 to have been very much below the mark.

Many in the Canadian mining industry believe that prospecting and exploration now being carried on all over Canada, even into the Arctic Circle, will within fifteen years demonstrate Canada as the world's greatest copper producer, though developments in Africa have, of course, to be taken into account in forecasting progress within the next few years.

INCREASE IN CANADIAN IRON AND STEEL PRODUCTION.

The Dominion Bureau of Statistics at Ottawa, in its monthly statement for December on the production of iron and steel in Canada, records a 46 per cent. increase in pig iron production and a 37 per cent. increase in the output of steel ingots and castings for the calendar year 1928.

During the year the production of pig iron and primary steel in Canada reached the highest level attained since the record year 1918. The output of pig iron totalled 1,037,585 long tons, as compared with 709,697 tons in 1927, this gain being reflected in the production of steel ingots and direct steel castings totalling 1,240,214 tons, as against 907,688 tons for the previous year. The increased demand for rails,

track equipment and rolling stock by the railroads was one of the principal factors contributing to the gain in steel production. Other stimulating factors included greater requirements from the construction industry, the automobile industry, the agricultural implements industry, the mining industry and power development enterprises.

Production of pig iron in Canada per capita of population amounted to 241 pounds in 1928 as against 167 pounds in the previous year, 178 pounds in 1926 and an average of 136 pounds in 1925. In steel ingots and castings the per capita production in 1928 amounted to 288 pounds compared with 213 pounds in 1927, an average of 185 pounds in 1926, and 180 pounds in 1925.

The situation in the iron and steel industry at the end of 1928 as disclosed by the Bureau was that on December 31st eight blast furnaces were in operation in Canada, 3 at Sydney, Nova Scotia; 2 at Hamilton, Ontario; 2 at Saulte Ste. Marie, Ontario; and 1 at Port Colborne, Ontario. These furnaces had a total capacity of 3,075 long tons per day or about 75 per cent. of the total capacity of all blast furnaces in Canada, the total number of stacks being reported as 11 and total daily capacity as 4,125 long tons.

During December, production of pig iron in Canada totalled 103,450 tons which was the highest output reported for any month of the year, being 8 per cent. over November and 64 per cent. over December, 1927. December production of steel ingots and castings at 103,054 tons was slightly under the output of 108,463 tons reported for the previous month.

IMPERIAL CHEMICALS EXHIBIT AT THE BRITISH INDUSTRIES FAIR.

An outstanding exhibit of this representative Fair of Imperial trade is that of Imperial Chemical Industries Limited, which by the artifice and technique of display and arrangement conveys to the buyers an impression of the united front presented by over forty subsidiary and associated companies operating throughout the Empire and the world.

The exhibit comprises the principal products of Imperial Chemical Industries and includes heavy chemicals, explosives and ammunition, dyestuffs, metals, fertilisers, all of which are shewn on a large site which has for its central feature a cinema hall. Here films will be shewn continuously, illustrating the manufacture of heavy chemicals: "The Story of Beautiful Colours," wherein comes the making of dyestuffs; "The use of Blasting Explosives," depicting a fall of 30,000 tons of limestone; and a film shewing by examples the uses of fertilisers and their benefit to agriculture.

Overseas buyers to the Fair need no reminder that the products of this great Company are exported to all parts of the world where Imperial Chemical Industries has representatives and agents totalling nearly five hundred, so that the most distant outpost of the company becomes a link in a chain by which the buyer may avail himself of the vast resources and researches of Imperial Chemical Industries.

Buyers visiting the White City will be able to obtain information concerning the products of Imperial Chemical Industries from representatives on the stand, and literature dealing with specific products will be available.

COAL OUTPUT UNDER THE FIVE COUNTIES SCHEME.

The following official statement is issued by Mr. Philip Gee for and on behalf of Messrs. Peat, Marwick, Mitchell Co., the Secretaries of the Central Collieries Commercial Association (commonly known as the Five Counties Scheme):

"It has been observed that in statements which have recently been made in the Press and elsewhere there is a misconception as to the degree to which the output of coal has been curtailed by the operations of the Central Collieries Commercial Association (sometimes described as the Five Counties Scheme).

"Members of the public may have seen references to monthly 'quotas' ranging from 56 to 70 per cent., and may therefore have thought these figures represented drastic reductions from the production prior to the commencement of the Central Association.

"These 'quotas' are merely factors in a formula and are not related to actual output produced in any past year.

"The following figures shew the total tonnage actually raised at all collieries in the districts affected by the Central Association in 1927 and 1928.

Year ended 31 December, 1927	109,660,065
Year ended 31 December, 1928	102,641,285
Decrease	7,018,830

"This decrease of 7,018,830 tons is equivalent to 6.4 per cent. for the whole year."

TESTING 200 VARIETIES OF SCOTTISH COAL FOR UTILISATION IN NEW INDUSTRY.

In anticipation of the completion within the next few months at Glenboig (Glasgow) of the largest plant in the world devoted to the scientific treatment of coal by low temperature distillation, the Bussey Coal Distillation Company has inaugurated an exhaustive analysis of coals taken from every coalfield in Scotland with a view to selecting the most suitable type for giving a high yield of oil, gas and smokeless fuel. This is the first complete scientific analysis of a nation's coal deposits ever undertaken.

The whole of the Scottish coalfield has been surveyed, and chemists are now subjecting to standard tests over 200 widely differing varieties of coal from the "black" district extending from Edinburgh to Glasgow.

The experiments, which are being carried out under conditions of strict secrecy, are being carefully watched as the possibility exists that important derivatives will be produced. Already a wide range of remarkable by-products, embracing explosives, synthetic drugs, resins, disinfectants, creosoting compounds and high-finish varnishes have been obtained.

Some of the articles made from synthetic resins alone comprise knife-handles, telephones, motor-car steering wheels, side curtains, pipe stems, umbrella handles, piano keys, and toys, so that the by-products of coal distillation under the Bussey process open up a wide range of possibilities.

FEDERATION OF BRITISH INDUSTRIES.

1929 FORECAST.

Past experience provides no example of active and expanding trade under monetary conditions as at present persisting in Great Britain. It is not possible, therefore, even with the best will in the world, to look forward during 1929 to anything more than an acceleration of the more favourable developments of 1928, assisted by such orders as may be placed by the Central Electricity Board and any other similar public schemes which may be instituted during the year.

If the monetary cloud could be lifted—either by some specially arranged shipments of gold, or a modification of the fiduciary portion of the Note issue—so as to permit of a reduction in the Bank Rate and an expansion of credit, there would be nothing in the other factors of the industrial situation to prevent trade going ahead.

The American monetary situation continues to be full of difficulties and dangers for Europe. No one can predict whether or not further steps to check New York speculation will be taken, or what further assistance, if any, will be afforded European countries to enable them to complete the task of replenishing their gold reserves. In the absence of American action, the present International Stock Exchange boom may be expected to continue, accompanied by a growing maladjustment between the supply of capital for investment and speculation, and liquid capital in the form of bank credit available for industrial purposes, which is a disquieting feature of our Home situation. Conditions abroad are on the whole favourable. In Europe the fall in the German Bank Rate is a highly propitious event, as it should remove the possibility of further gold exports from this country to Germany, and reduce the fear lest the prospect of a reopening of the reparation discussion should be made the excuse by the Reichsbank for maintaining an unduly tight rein on German credit. In South America conditions are distinctly promising in Chile and the Argentine, while in the Far East the re-establishment of treaty relations with China should have beneficial results.

REPORT ON THE FERMENTATION INDUSTRIES FOR 1928.

A Report on the Fermentation Industries during 1928 has been prepared for the Society of Chemical Industry and the Institute of Brewing by Mr. H. Lloyd Hind, B.Sc., F.I.C., and Mr. F. E. Day, B.Sc., F.I.C . The Report deals with the progress made during the year and is especially concerned with the published report results of scientific investigations. It opens with a summary of Prof. Lindner's paper on the problems of fermentation which he likens to the Sphinx whose riddle still awaits solution. A wider knowledge of the activities of cell life may give the clue to the outstanding difficulties. As in almost every other sphere of applied science much work has been published recently upon the phenomena of fermentation and the authors of the Report are to be congratulated for producing a readable survey of the results obtained. References to the originals are fully given.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Papers read on Thursday, February 21 :

The Change in Electrical Conductivity in Strong Electric Fields. Parts I and II. By P. Kapitza. Communicated by Sir Ernest Rutherford, P.R.S.

Improvements in method of measuring change of resistance in strong magnetic fields are described, and change of resistance in a transverse field at room temp., temp. of solid CO_2 and ether, and temp. of liquid nitrogen, has been studied in the following metals :—Ii, Na, Cu, Ag, An, Be, Mg, Zn, Cd, Hg, Al, Ga, In, Tl, C, Ti, Ge, Zr, Sn, Pb, Th, V, As, Sb, Bi, Ta, Cr, Mo, Te, W, Mn, Fe, Ni, Pd, Pt, gold-silver alloy, and Cu_3 As. Change of resistance in a parallel field was also measured for a few metals.

It was found that in all the metals the change of resistance follows the same law, which can be expressed by a formula fitting the experimental results quite well. This formula gives a square law in weak fields and a linear law in stronger fields. It is shown that the physical change produced in a conductor by hardening and annealing has a strong influence on the phenomenon of change of resistance, and the influence of impurities is also very marked and has been studied. A theory is given for the phenomenon of change of resistance in a magnetic field. It assumes that change of resistance follows a linear law with increasing field, and that in weak fields it is masked by disturbances existing in the metal equivalent to an internal magnetic field. On this assumption formulæ are obtained agreeing with experimental facts, and permitting separation of the ideal resistance and the additional produced by the internal disturbances.

It is shown that additional resistance is independent of temperature, and that ideal resistance has a constant value for a given temp. for each metal, independent of its physical and chemical state. It is also shown that the additional resistance is identical with the residual resistance which is observed at very low temperatures.

It is suggested that supra-conductivity is a general phenomenon in all metals but masked by presence of additional resistance, which disappears at very low temperature in certain metals.

The properties of the coefficient β of the linear law of change of resistance are examined, and it is shown that there is a connection between the value of β and the position of the element in the periodic system. The relation of change of resistance to position of element in the periodic system is also discussed. The bearing of the research on the modern theory of conductivity is considered, and it is shown that the phenomena observed cannot be adequately explained. Some tentative suggestions are advanced.

An Investigation of the Ranges of the Long-Range α-Particles from Thorium C and Radium C, using an Expansion Chamber. By I. S. Nimmo and N. Feather. Communicated by Sir Ernest Sutherford, P.R.S.

The long-range α-particles from the active deposits of radium and thorium have been investigated by several observers employing the scintillation method, and widely different results have been obtained. The method itself is not suitable for the accurate measurement of ranges, and becomes insensitive, even qualitatively, when there are several groups close together. It is possible to employ the expansion chamber so as to measure accurately the lengths of individual α-particle tracks. The radiotractive source was surrounded by an atmosphere of dry oxygen (or Carbon dioxide) and α-particles were admitted to the expansion chamber through a very thin mica window at a definite instant towards the end of the expansion. "Extrapolated" ranges 9.90 and 11.0 cms. in standard air were obtained for the long-range α-particles from thorium C.

The former group was first distinguished by Meitner and Freitag, using an expansion chamber. These workers found a ratio 1 : 2.8 between the abundance of the two groups; the present value is 1 : 5.1. 541 particles have been observed belonging to these groups. In addition 9 had ranges between 12.5 cms. and 17 cms. and 18 had longer ranges. Probably some of these particles of longer range are α-particles.

The range of the most abundant group of long-range α-particles from radium C was measured as 9.16 cms. In addition to this group it is likely that there are others with ranges 8.1, 10.0 and 11.0 cms. respectively. A few particles were found of still longer range. In all nearly 500 long-range particles from radium C were recorded. A short discussion concerning origin of long-range α-particles is appended.

Some Experiments on Vacuum Distillation. By C. R. Burch. Communicated by Sir Ernest Rutherford, P.R.S.

The method of evaporative distillation can be applied to the derivatives of petroleum. It enables distillations to be made which cannot otherwise be accomplished without decomposition. An elementary kind of fractionation is possible, and though intensive fractionation would need special apparatus, this would present no real difficulty. Petroleum derivatives of exceedingly low vapour pressure can be prepared, and some of these increase considerably the scope of the condensation pump.

The following papers were read in title only :—

The Photosynthesis of Naturally Occurring Compounds.—IV. By E. C. C. Baly F.R.S., and N. R. Hood.

Adsorption at a Water Surface.—I. By B. W. Currie and R. Alty. Communicated by Sir Joseph Thomson, F.R.S.

Some Adsorption Isothermals for a Plane Platinum Surface. By W. G. Palmer. Communicated by Sir William Pope, F.R.S.

Studies in Gas-Solid Equilibria. By B. Lambert and A. M. Clark. Communicated by F. Soddy, F.R.S.

Relative Velocities of the Alpha-Particles Emitted by Certain Radioactive Elements. By G. C. Laurence. Communicated by Sir Ernest Rutherford, P.R.S.

The Mechanism of the Homogeneous Combination of Hydrogen and Oxygen. By H. W. Thomson and C. N. Hinshelwood. Communicated by Sir Harold Hartley, F.R.S.

Electron-Scattering in Helium. By E. G. Dymond and E. E. Watson. Communicated by Sir Ernest Rutherford, P.R.S.

Diffraction and Resonance. By E. T. Hanson. Communicated by F. E. Smith, F.R.S.

(a) *The Forces on a Solid Body Moving Through Viscous Fluid.* (b) *The Steady Flow of Viscous Fluid Past a Fixed Spherical Obstacle at Small Reynolds Numbers.* By S. Goldstein. Communicated by H. Jeffreys, F.R.S.

Oseen's equations for the flow of a viscous fluid at small Reynolds numbers past a fixed spherical obstacle are solved completely, and a table given of the resulting values of the drag coefficient.

On the Chemical Interaction of Ions and the " Clean-up " of Gases at Glass Surfaces charge. By J. Taylor. Communicated by Sir Joseph Thomson, F.R.S.

The Total Reflexion of Electric Waves at the Interface Between Two Media. By H. M. Macdonald, F.R.S.

On the Measurements of the Dielectric Constants of Liquids, with a Determination of the Dielectric Constant of Benzine. By L. Hartshorn and D. A. Oliver. Communicated by W. D. Dye, F.R.S.

The Wave-Equations in Five Dimensions. By J. W. Fisher. Communicated by O. H. Richardson, F.R.S.

Measurements of Flame Temperatures. By E. Griffiths, F.R.S., and J. H. Awbery.

The Structure of the Benzene Ring in $C_6(CH_3)_6$. By K. Lonsdale. Communicated by N. Whiddington, F.R.S.

THE OPTICAL SOCIETY.

At the meeting of the Optical Society held at the Imperial College of Science and Technology, South Kensington, on Thursday, 13 February, the following paper was read and discussed :—

An Application of the Interferometer to the Goniometry of Prisms. By D. S. Perfect, M.A., D.Phil. (Optics Department, The National Physical Laboratory.)

A method is described by means of which the goniometry of prisms may be effected with an accuracy of about 0.1 sec. The chief apparatus consists of a Hilger Interferometer No. 1, to which small additions are made, and a hollow prism, the deviation due to which may be varied by altering the pressure of the air within it. A manometer connected to the prism provides a linear scale of angles, having calculable constants, and the directional coincidence of the fringe systems with a horizontal cross-wire provides the criterion by which settings are made.

A vote of thanks to Dr. Perfect was moved from the chair and carried with acclamation.

Demonstration. — By the courtesy of Adam Hilger, Limited, the latest model of the " Coker photo-elastic apparatus " made by the firm was exhibited and described by their representative, Mr. Hardy.

In this apparatus models of structural elements in nitro-cellulose can be placed under stress, and the distribution and direction of the various stresses set up in the section can be examined by means of polarised light. By means of a comparison model the stress at any point can be determined in magnitude and direction and the

results obtained are of great use in showing the distribution of stress in elements employed in structures and in machines. Measurements can be obtained rapidly and easily.

The apparatus is also of considerable value as an educational apparatus for demonstrating the stresses set up in structural elements as it is possible for these effects to be demonstrated to a comparatively large number of students at one time. Mr. Hardy demonstrated the stresses set up in a variety of sections of different kinds.

A vote of thanks to Messrs. Hilger for exhibiting the instrument and to Mr. Hardy for the able way in which he explained and demonstrated the apparatus was carried with acclamation.

THE PHYSICAL SOCIETY.

February 22.

The following papers were read :—

The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measure ment of High Vacua. By L. F. STANLEY, *A.R.C.S., B.Sc., Research* Student, The Royal College of Science.

The low pressure gauge described consists of a manometer and a compensator, the one identical with the other, placed in the opposite arms of a Callendar-Griffiths bridge; each consists, essentially, of a loop of 10 cm. of platinum wire, of 0.001 inch diameter, together with a compensating loop of 2 cm. of the same wire. The symmetry of the circuit makes errors due to thermoelectric effects very small. Investigations have been carried out to ascertain how the sensitivity of the instrument depended upon :

(1) The diameter of the gauge.
(2) The temperature of the wire.
(3 The temperature of the external walls.
(4) The nature of the material of the exnal walls.

The gauge constructed follows variations of pressure with considerable rapidity, and its range of measurement is from 2×10^{-3} mm. to 4×10^{-6} mm. approximately.

The Free Periods of a Composite Column or Composite Stretched Wire. By CHARLES H. LEES, D.Sc., F.R.S.

The free periods of the longitudinal oscillations of an elastic column, one portion of which has different elastic properties from the remainder, are determined for different positions of the junction when both ends of the column are nodes, when one is an antinode, and when both are antinodes. A graphical method of dealing with the problems is developed. Observations in the case of a composite stretched wire agree with the theoretical results.

A Capillary Tube Method for the Simultaneous Determination of Surface Tension and of Density. By ALLAN FERGUSON, M.A., D.Sc., AND J. A. HAKES, B.Sc.

A capillary tube of radius r is immersed vertically to a depth h_1 in the liquid of density ρ_1 under test. Tube pressure $g\rho h$ required to force the meniscus down to the lower end of the capillary and to hold it there is measured. If h_1 and consequently h be varied, a plot of h against $(h_1 - r/3)$ gives a straight line from whose slope and intercept the surface tension and the density of the liquid may be inferred.

A Demonstration of a standard electrostatic voltmeter and wattmeter, used for measurements of alternating currents at power frequencies at the National Physical Laboratory, will be given by Dr. E. H. RAYNER.

FARADAY CENTENARY.

On January 15 an important meeting of scientists was held at the Royal Institution to arrange for the selebration in 1931 of the centenary of Michael Faraday's great discoveries in electro-magnetic induction. The meeting was held in the hall where Faraday made his first announcement to the Royal Society and to the world.

It was on August 28, 1831, that Faraday made his first successful experiments, and in November of the same year he communicated to the Royal Society a paper describing the result of his work.

This was the most important of the discoveries on which modern electrical science and the industries which have sprung from it are based. Its vast importance will be reflected in the celebrations in which numerous bodies, scientific and industrial, and many countries, will be represented.

On a table in front of Sir Arthur Keith, the treasurer of the Royal Institution, who presided at the meeting, was the original electric ring—iron wound round with copper wire—with which Faraday obtained the first spark. There was also on view the record in Faraday's own writing of the experiment, and a rough diagram illustrating it.

A number of societies and organisations were represented, including the Royal

Society, the British Association, the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Electricity Commissioners, and the British Broadcasting Corporation.

Sir Arthur Keith said that Faraday was one of the greatest of Englishmen. It was right that they should meet there, for the Royal Institution was not only Faraday's workshop, but his home for fifty-four years.

"Here," said Sir Arthur, "this 'favoured spirit '—to borrow a recent phrase of Einstein — thought and discovered, and his thoughts and discoveries have in their result revolutionised the conditions under which we live. Faraday was the Royal Institution—his spirit is still here."

By a fortunate coincidence, the centenary of the British Association also fell in 1931, and other important conferences on electrical matters were also times to take place in London in the same year.

Sir William Bragg, Sir Ernest Rutherford and a number of others spoke in support of the movement.

PHARMACEUTICAL SOCIETY'S CONVERSAZIONE.

The Pharmaceutical Society held a Conversazione at the Society's House, 17, Bloomsbury Square, on February 12, when the rooms and laboratories were open for inspection.

In the Pharmacoloical Laboratory the action of acetyl choline and digitalis upon a rabbit's heart and the action of pilocarpine on the heart of a frog were demonstrated. In the section devoted to the testing of vitamine preparations, charts showing growth curves and absorption curves were shown.

Demonstrations of the Tyndall Cone and Brownian Movement in colloidal solutions were explained in the Preparation Room. In the Museums were exhibits illustrating common adulterants of drugs and collections of 17th century drugs, *e.g.*, scorpions, millipedes, crabs' eyes, etc. In the libraries a number of old, historical and important books were on view, including some early "Herbals."

Syntheses of Guaicol carbonate, Phenacetin, Acetanilide, Saccharin, and other organic substances were in progress in the chemical laboratories, where also the methods of testing preparations and determining physical and chemical constants. Charts showing the formation of new local anæsthetics were also shown.

APPLIED PHYSICS.

The Institute of Physics (Lowther Gardens, Exhibition Road, S.W.7.) has recently inaugurated a series of Lectures dealing with the applications of Physics to specific industries. One of the early lecturers in this series was Prof. W. E. S. Turner (Sheffield) who dealt with "The Physicist in the Glass Industry." He explained that few arts and industries known to early civilisations have preserved so much of their secrets until recently as the art of glass-blowing. Indeed, despite the rapid intrusion of science, it is by no means extinct. Many advances have been of a mechanical nature, but science, too, has had its share. Kunckel, the chief German contemporary of Boyle not only translated works into German but amplified the known receipts. Fraunhofer and Faraday both made useful contributions to our knowledge of optical glass. The chemist and physicist took a greater share in the progress when Schott the chemist, and Abbé the physicist, founded the Jena firm. Now there is complete physical control of the production of glass. Instances were given of automatic devices to ensure evenness of temperature, size and composition and a description of modern industrial laboratories were given.

In his lecture on "Physics in the Food Industry," Sir William Hardy, F.R.S., dealt with modern applications for the storage and preservation of foodstuffs, especially in connection with refrigeration.

"Physics in Astronomy" was the title of Sir Frank Dyson's Presidential Address to the Institute in May last and dealt with the indebtedness of Astronomy to Physics. This includes the making of refined instruments of all kinds, *e.g.*, exceedingly accurate clocks, telescopes of great magnification and a knowledge of such physical phenomena as hardness, friction, elasticity, expansion with temperature, etc.

The latest of the "Physics in Industry" Lectures was delivered on July 12, by Dr. C. E. Kenneth Mees, who discussed "The Physics of Photography." He considered the physics and chemistry of the behaviour of light sensitive substances and the application of their properties to photographic work.

It is to be seen that in all these industrial fields a knowledge of physics has played an ever increasing part. The Institute of Physics has reprinted these lectures and the pamphlets may be obtained at 1s. each.

Forthcoming Events.

ROYAL INSTITUTION.

Friday, March 1, at 9 p.m.—Sir Robert Robertson : " Infra-Red Spectra."

Saturday, March 2, at 3 p.m.—Sir Ernest Rutherford : " Molecular Motions in Rarefied Gases."

Monday, March 4, at 5 p.m.—General Meeting.

Tuesday, March 5, at 5.15 p.m.—Prof. J. S. Huxley : " Evolution and the Problem of Species."

Thursday, March 7, at 5.15 p.m.—Rev. Wm. H. Draper : " The Use of Language and its Difficulties."

Friday, March 8, at 9 p.m.—Prof. T. F. Tout : " The Place of Women in Later Mediæval Civilisation."

Saturday, March 9, at 3 p.m.—Sir Ernest Rntherford : " Molecular Motions in Rarefied Gases."

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London.

Shaw Lectures—Session 1928-29.

" Thirty Years' Experience of Industrial Maladies." By Sir Thomas Morison Legge, C.B.E., M.D. (Late Senior Medical Inspector of Factories, 1898-1927). A Lecture on Monday evening, March 4, at 8 p.m. The lecture will be illustrated by lantern slides.

Syllabus.

Lecture III. March.—Twenty Years' Experience of Compensation for Industrial Diseases. The wide net of the Compensation Act. Twenty-eight diseases and forms of poisoning scheduled. Reasons for exclusion of some. Results obtained as shown in the chart. Dominance of miners' maladies. Increase in dermatitis. Increasing importance of silicosis and help given by the action of the South African Government in dealing with it.

Wednesday, March 6, at 8 p.m.—(Ordinary Meeting). Tom Purvis : " Commercial Art : Its Value in Business and Art." Percy V. Bradshaw, Principal, Press Art School, will preside.

Friday, March 8, at 4.30 p.m.—(Indian Meeting). W. H. Moreland, C.S.I., C.I.E. : " The Indian Peasant in History : An Introduction to the Linlithgow Report." Sir Edward D. Maclagan, K.C.S.I., K.C.I.E., will preside.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

Department of Chemistry.

A Public Inaugural Lecture on "The Four Component System in Peace and War," will be delivered by Dr. F. A. Freeth, O.B.E., F.R.S. (Honorary Lecturer in the Theory and Practice of Heterogeneous Equilibria), on Friday, 1 March, 1929, at 5.15 p.m. The Lecture is open, without ticket, to all Students of the University and others interested in the subject.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

3,905.—Hercules Powder Co.—Denitrating acid mixtures, etc. February 5th.

4,258.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of organic acids. February 8th.

4,052.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of phenoxy quinoline carboxylic acids, etc. February 7th.

3,910.—Wachter, W. — Production of crystalline mixtures of salts. February 5th.

4,145.—I. G. Farbenindustrie Akt.-Ges. — Process for separating formic acid from acetic acid. February 7th.

Specifications Published.

305,147.—Dreyfus, H. — Manufacture of alophatic anhydrides.

300,177.—I. G. Farbenindustrie Akt.-Ges. Process for the manufacture of urethanes of secondary alcohols.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

302,806.—Nitrogen; hydrogen; ammonia. —Soc. D'Etudes Minieres et Industrielles, Ibis, Rue du Havre, Paris.

Nitrogen or hydrogen or mixtures thereof for ammonia synthesis are purified from

oxygen and from oxidisable impurities such as carbon monoxide and acetylene and other hydrocarbons and reducible impurities such as sulphur and phosphorus compounds by passing the gases at a temperature which, except in the case of nitrogen, must not exceed 600° C. over carbon, *e.g.*, wood charcoal. A small quantity of water vapour must be present in the gases. Pressure may be employed in the reaction. Oxygen or air or hydrogen may be added, when necessary, to the gases before the treatment in quantities sufficient to ensure removal of the impurities. The conversion products of the impurities are removed by any suitable process, carbon dioxide being for example removed by caustic soda or potash, and sulphuretted hydrogen and phosphine by absorption in chromic acid.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DIGINUTIN.

498,073.—Chemical substances prepared for use in medicine and pharmacy.—The Wellcome Foundation, Ltd., 67, Holborn Viaduct, London, E.C.1. February 13th.

INSTILL.

495,137.—Chemical substances for use in the manufacture of oils and spirits for motive power, heating and lighting.—Refiners, Limited, 3, Parsonage, Manchester. February 13th.

NAPHTOKAL.

497,584.—All goods in class 1 which includes acids, potash, salts, and other chemical substances used in manufactures.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort - on - Main, Germany. February 13th.

"EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News.*
Price 5s.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.

Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3595.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.

Printing Works: Hop 2404.

CONTENTS. PAGE.

Michelson-Morley Experiment 145
By F. H. Loring.

The Action of Air-Carbon Tetrachloride Vapour Mixtures on Certain Natural and Artificial Sulphides, Selenides and a Telluride 147
By K. Braddock-Rogers.

Twelfth Exposition of Chemical Industries, New York 153

General Notes 154

Proceedings & Notices of Societies:—

The Chemical Society 155

The Chemical Society of Japan 157

Collection of Czechoslovak Communications 157

Notices of Books 157

Forthcoming Events 159

New Patents 159

New Trade Marks 160

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

MICHELSON-MORLEY EXPERIMENT.

In the *Astrophysical Journal* for December, 1928, there is a full report of the Conference on the Michelson-Morley Experiment —pages 341 to 402. Papers are here given which were read at the conference by Professors A. A. Michelson, H. A. Lorentz, D. C. Miller, R. J. Kennedy, E. R. Hedrick, P. S. Epstein, followed by a discussion opened by Dr. W. S. Adams, director of Mount Wilson observatory.

Although this publication is late in appearing, the subjects discussed are of great interest to-day, as it was the *null* result in the famous Michelson-Morley experiment that formed a basic feature in the theory of relativity.

The M.-M. experiment was originally devised to determine optically the velocity of the earth through space. It was thought that if the light waves took place in a stationary æther the earth's relative velocity (relative to the æther) would be shown by the displacement of the interference fringes in the eyepiece of the instrument so designed as to bring about this result.

After repeated trials the expected effect, a second-order one involving squared terms, was not observed; but, later D. C. Miller obtained effects which stimulated still more research, and the very latest results point again to a zero displacement in accordance with the theory of relativity.

As to the *æther*, it does not exist as originally conceived, but the least said here the better as we are in almost total ignorance of it. Prof. Michelson says: "I personally still cling a little to it."

The null result could be accounted for on the assumption that the æther immediately surrounding the earth clings to it; or, alternatively, that the planets are bedded in a huge whirling disc or lens-shaped body composed of the æther, the sun being at the centre, the earth's orbital velocity happening to coincide very closely with that of the whirling æther.

The problem is now somewhat altered, for there are the following motions to consider:—

1. The earth's rotation on its axis. This is small in terms of velocity and need not be considered as compared with the orbital velocity. The equatorial velocity is about 1500 feet a second.

2. The earth's orbital motion of about 20 *miles a second.*

3. The drift of the solar system in our galactic system of about 12 miles a second.

4. The movement of our own galactic system amongst other galactic systems (spiral nebulæ) at a speed of 250 miles a second. . .

5. And perhaps so on, *ad infinitum.* Who knows!

If there are *n* motions at *n* angles with each other, the resultant motion cannot always be zero, as there must be *periodic* resultant effects, basing this statement on the original idea of an unique stationary æther, whatever this may mean. In this case it would be expected that the earth's orbital motion would reveal itself, though a superposed motion. It is customary to discuss these pros and cons apart from the theory of relativity.

Mentioning an outstanding feature of the conference D. C. Miller's Mount-Wilson findings, though positive, did not coincide with the results as might have been expected from the earth's orbital motion. This is, however, favourable in a way, because there are other motions involved even greater than that of the earth round the sun—at least one such possible motion as stated above. Accordingly, a resultant effect would be expected on the hypothesis of a stationary all-prevading æther.

Later results by both Kennedy and Michelson give *again* the *null* result. Prof. Michelson states that under extremely favourable conditions shifts to a minimum extent of 1/1000th of a fringe can be measured.

In these experiments the greatest possible care has to be taken to prevent disturbances which would affect the readings. To avoid heating effects Miller coated his apparatus with cork. Undreamt of refinements have been resorted to.

While Miller's findings have not been confirmed, the work he carried out is so monumental that it deserves special consideration. Miller claims that the result " was never numerically zero, not even in the original Michelson and Morley experiment. . it was zero in so far as the motion of the earth in its orbit is concerned." Of course, the experimental error may be such as to make it necessary to discount very small effects, but the remarkable fact remains that Miller did get systematic results pointing to a certain direction of movement of about 200 kilometres a second. These are Miller's own words: " A calculation based on the observations of 1925 was made to determine the absolute motion of the earth. The result of this, as reported at the Kansas City meeting, indicated that the solar system is moving towards an apex in the constellation Draco with a velocity which is in excess of 200 km/sec." Then finally Miller says:—

" The values of the quantities defining the absolute motion of the solar system as obtained from these ether-drift observations are in general agreement with the results obtained by other methods. The recent study of proper motions of stars by Ralph Wilson, of the Dudley Observatory, and of the radial motions of the stars by Campbell and Moore, of the Lick Observatory, gives the apex of the sun's way in the constellation Hercules with a right ascension of 270° and a declination of about +30°, with a velocity of about 19/km./sec. Dr. G. Strömberg, of Mount Wilson Observatory, from a study of globular clusters and spiral nebulæ, finds evidence of a motion of the solar system toward a point having a right ascension of 307° and a declination of +56°, with a velocity of 300 km/sec. Lundmark, studying the spiral nebulæ, finds evidence of a motion having a velocity of 400 km/sec. The various determinations of the motion of the solar system are all in the same general direction and lie within a circle having a radius of 20°. Our assumed velocity of 200 km/sec. is simply a lower limit; it might equally be 300 or 400 km/sec. The first assumption therefore seems to offer no difficulty. The location of the apex in the constellation Draco at right ascension 255° and declination +68°, is within 6° of the pole of the ecliptic, that is, the indicated motion of the solar system is almost perpendicular to the plane of the ecliptic. The sun's axis of rotation points within 12° of this apex. One cannot help wondering whether there may be some dynamic significance in these facts."

Miller's experiments stimulated further investigations and the experiment of Prof. Kennedy stands out as one of exceptional brilliancy. In this experiment new refinements were introduced. In particular the use of a specially prepared divided mirror which was made by covering part of a plane plate with a flat sharp-edged microscope

cover-glass and applying the extra thickness by cathode deposition of platinum, then giving the whole plate a fully-reflecting coat, to quote practically Prof. Kennedy's words. Also polarised light impinging at the proper angle on the plate was used to avoid excessive scattering. The ray paths were in helium instead of air. Prof. Michelson speaks highly of Kennedy's apparatus and expressed the regret that he had not been able to use it having started new experiments with the older type of apparatus. The apparatus was sensitive enough to show a deflection four times the least detectable by theory according to Prof. Kennedy. No sign of any shift appeared when the orientations were made. This was confirmed by Illingsworth at the California Institute of Technology, who concludes that *no* æther drift as great as one kilometre a second exists.

Prof. Hedrick discussed the theory of the optical scheme involved in these experiments and pointed out the possibility of a numerical result different from that ordinarily expected on the basis of the classical theory.

Further discussions of a highly technical and scientific nature cannot be dealt with here.

Michelson's latest result coupled with those of Kennedy and of Illingsworth, mentioned above, seem to point again to the null finding and the theory of relativity is not shaken by these experiments, though Miller's results stand out as exceptional and probably more will be heard on this interesting subject.

It appears, according to a statement made by Prof. Miller, that *altitude* in no way affects the results obtained.

A rather new feature, not mentioned above, is of interest in this connection. It appears from astronomical researches that our galactic system is rotating or reovlving, and that the centre of the galactic system is further away than was originally supposed. The rotation is estimated at one turn in 10^8 years.

The *centred part* of our galactic system (about 55,000 light years across) is in the great star swarm of the Milky Way and is hidden behind dark obscuring matter.

The earth's orbital revolution is sensibly a straight-line motion so far as these experiments are at present concerned. The galactic revolution would even be more so.

F. H. L.

THE ACTION OF AIR-CARBON TETRACHLORIDE VAPOUR MIXTURES ON CERTAIN NATURAL AND ARTIFICIAL SULPHIDES, SELENIDES AND A TELLURIDE.

By K. Braddock-Rogers.

(*Contribution from The John Harrison Laboratory of Chemistry of the University of Pennslyvania.*)

Carbon tetrachloride was first used by Watts and Bell in 1878 (*J. Chem. Soc.*, 1878, XXXIII, 442) for the preparation of several metallic chlorides. While this reagent has been used in the preparation of a long list of substances, it has seldom been employed for quantitative purposes. Jannasch and Harwood (*J. pr. Chem.*, LXXX, 134) volatilised B_2O_3 from boric acid in a current of carbon tetrachloride and methyl alcohol; V_2O_5 from ammonium meta-vanadate and from sodium vanadate in a stream of carbon tetrachloride. These investigators applied this reaction to the analysis of vanadinite, endlichite, and carnotite. Jannasch and Jilke (*ibid.*, p. 113) removed phosphorus from the phosphates of iron, chromium, zinc, nickel, cobalt, and manganese with carbon tetrachloride vapour.

Camboulives (*Compt. Rend.*, 110, CL, 221) heated a number of minerals in carbon tetrachloride vapour. Those which he reported are corundum, wolframite, anhydrous silicates, albite, emerald, orthose, oligoclase, labrodorite, anorthite, cymophane, chromite, columbite, scheelite, spinel, and emery.

E. F. Smith (A Monograph—"Sodium Tungstates," July, 1924, Phila., P.; see also *Chem. News*, 1927, CXXXV, 113) decomposed the tungstates of barium and sodium and lead meta-tungstate by heating them in a stream of carbon tetrachloride.

Moser and Schmidt (*Monats. fur Chem.*, 1926, XLVIII, 313) used mixtures of carbon tetrachloride and carbon dioxide, and carbon tetrachloride and air on scheelite, sodium tungstate, WO_3, ammonium tungstate; and to separate tungsten from iron; WO_3 from Fe_2O_3, and to test the purity of amorphous tungsten and tungsten wire.

From this brief review of the previous work with carbon tetrachloride it is apparent that nothing has been done on sulphides, selenides, and tellurides. It is the purpose of this paper to show the application of this reagent to those substances.

Purification of the Agents.

Ammonium hydroxide.—A solution of ammonium hydroxide, redistilled (Sp. Gr. .94) was kept in cerisen bottles.

Hydrochloric acid-bromine mixture.—Into a Greiner and Friedrichs (*Z. anal. Chem.*, (1911, L, 175) gas washing bottle were placed 75 ccs. of bromine water and 5 ccs. of bromine water and 5 ccs. of bromine. This bottle was connected to a second bottle of the same type containing 60 ccs. of concentrated hydrochloric acid. Air was drawn through this system for four to five minutes at the rate of 1800-2000 ccs. per hour. In this way bromine may be introduced into hydrochloric acid without any contamination from sulphates. By varying the time and the rate any desired concentration of bromine in hydrochloric acid may be obtained.

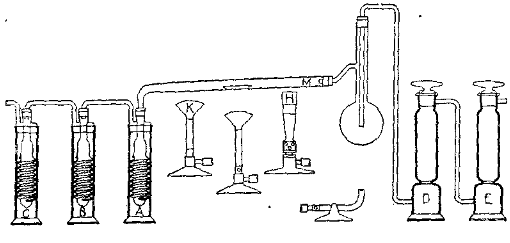
Hydrogen peroxide.— The hydrogen peroxide of commerce contains sulphates which must be removed. An excess of barium peroxide was added to a litre of hydrogen peroxide. The solution should be at room temperature, shaken occasionally and allowed to stand one and a half hours and then filtered through asbestos. The hydrogen peroxide could be preserved without appreciable loss in strength for several days. The portion of hydrogen peroxide in each analysis just before use, was treated with an excess of ammonium carbonate, allowed to stand four to five minutes, shaken once, and filtered through asbestos. The hydrogen peroxide was ready for use.

Ammoniacal Hydrogen peroxide.—Equal volumes of the 3 per cent. purified hydrogen peroxide and the distilled ammonium hydrox 0.94 specific gravity.

Carbon tetrachloride.—Carbon tetrachloride sold as "sulphur free" was allowed to stand in contact with solid potassium hydroxide for several days and then distilled. The distillate was dried over calcium chloride and again distilled. A test for sulphur was made on this material.

The carbon tetrachloride was heated to 60-65° C. Air free of carbon dioxide and moisture was drawn over it for forty minutes at the rate of 1500 ccs. per hour. The air laden with vapours of carbon tetrachloride was heated to 750-800° C., and the resulting gases were absorbed in 75 ccs. of ammoniacal hydrogen peroxide (*q.v.*). The contents of the absorbing flask were washed into a beaker and boiled to expel the excess ammonia, acidulated with hydrochloric acid and tested for sulphates with a solution of barium chloride. A very considerable quantity was found.

The sulphur in the carbon tetrachloride may be easily removed. Three parts of carbon tetrachloride are very vigorously shaken with two parts of 1 : 1 ammoniacal hydrogen peroxide. This treatment is repeated at least three times with fresh oxidising material. No definite statement as to the number of times this treatment is to be repeated can be given. The carbon tetrachloride is dried over calcium chloride and distilled and again tested for the presence of sulphur in the manner described. If sulphur is again found to be present the treatment with ammoniacal hydrogen peroxide is to be repeated. No difficulty was experienced in completely and efficiently removing all traces of sulphur compounds.



THE APPARATUS.

A.—Absorber containing hydrochloric acid bromine mixture.
B. & C.—Absorbers containing ammoniacal hydrogen peroxide.
D.—Calcium chloride drying tower.
E.—Potassium hydroxide tower.
F.—Carbon tetrachloride reservoir 125 ccs. capacity.
M.—Clear quartz tube, 88 cm. long and 1.7 cm. bore.
H.—Portion of tube above burner 5-7 cm. heated 750-800° C.
K.—Portion of tube above burner 3-5 cm. heated 400-450° C.

The towers D and E washed the air free of moisture and carbon dioxide. The air was drawn through the system by a water aspirator (not shown in the picture) attached to C. The air inlet tube of the carbon tetrachloride reservoir should be from one to two cm. above the surface of the liquid. The connections of the absorbing bottles were butted together in rubber sleeves.

The absorbers were Greiner and Friedrichs spiral bubbling (*q.v.*).

The boats and the tubes were of clear quartz on which the reacting gases had no effect.

The General Procedure as Applied to the Analysis of Sulphides.

All samples of minerals were ground to pass through a sieve of one hundred meshes to the inch. The sample of mineral was weighed in quartz boat and introduced into the centre of the decomposition tube. The air was drawn through the apparatus at the rate og 1500-1700 ccs. per hour over carbon tetrachloride heated to 40-50° C. The gases passed through the hot portion of the tube over burner H, where presumably the following reactions took place,

$$2CCl_4 = C_2Cl_4 + 2Cl_2$$
$$2CCl_4 = C_2Cl_6 + Cl_2$$
$$(C_2Cl_6 = C_2Cl_4 + 2Cl_2)$$
$$C_2Cl_4 + 2O_2 = 2CO_2 + 3Cl_2$$
$$C_2Cl_6 + 2O_2 = 2CO_2 + 3Cl_2$$
$$2CCl_4 + O_2 = 2COCl_2 + 2Cl_2$$

These gases next passed over the mineral iu the boat, which is decomposed as follows :—

$$RS + 2Cl_2 = S_2Cl_2 + RCl_2$$
$$RS + COCl_2 = COS + RCl_2$$

The heat applied at K prevents condensation of the volatile chlorides about the end of the boat. The products of the reaction entered the absorption bottles where the sulphur compounds were oxidised to sulphates. The temperature of decomposition and other conditions are stated under each substance.

The volatile chlorides in the decomposition tube were united with the contents of the first absorber and the excess bromine and hydrochloric acid expelled by boiling. The contents of the alkaline absorbers were united, boiled to expel the excess ammonia and hydrogen peroxide and evaporated to dryness on the water bath. The residue was taken up in dilute hydrochloric acid and the solution filtered to remove the silica. (In every case silica was present from the action of the ammonia on the purex beakers.) This filtrate and the first acid solution were united and this solution is hereafter termed the "main solution," from which the sulphur was precipitated as barium sulphate. The treatment of the contents of the boat is described under the detailed analysis of each particular material.

Attempts were made to dispense with the acid absorber and use only ammoniacal hydrogen peroxide. This was not generally successful. The combination of acid and alkaline absorber fits any case and it is the procedure recommended.

The Analysis of Natural Sulphides.
Sphalerite.

The mineral was heated for fifteen minutes at 400 ° C. and then for twenty to twenty-five minutes at 500-550° C.

Two series of experiments were made. First, the absorbing and oxidising agent was ammoniacal hydrogen peroxide in four absorbing bottles. The contents of these absorbers were treated as described above. The volatile chlorides in the tube were added to the main solution. The residue in the boat contained the gangue and traces of zinc chloride which may be leached out with very dilute hydrochloric acid, filtered and the filtrate added to the main solution.

In the second series the first absorbing bottle contained a hydrochloric acid-bromine mixture (*q.v.*), the second and third bottles ammoniacal hydrogen peroxide. In every other respect the conditions of the experiments were the same.

Series 1.

Weight of Mineral	Sulphur
.2078 gm.	26.40 per cent.
.2105 ,,	26.38 ,, ,,
.2133 ,,	26.33 ,, ,,
.2115 ,,	26.33 ,, ,,
Average	26.33 ,, ,,
Series 2.	
.3250 gm.	26.41 per cent.
.3699 ,,	26.45 ,, ,,
Average	26.43 ,, ,,

Seven analyses made by other analysts in this laboratory by means of the usual procedure for the estimation of sulphur in minerals gave an average value of 26.34 per cent. sulphur for this sample.

Pyrites.

The mineral was warmed for twelve to fifteen minutes so that the ferric chloride

just formed above the boat. After which the temperature was increased to 450-500° C. The time of decomposition was about forty minutes. The boat containing the gangue and part of the copper chloride (if the mineral contained copper) was withdrawn, washed with hydrochloric acid, warmed for a few minutes, filtered, and the filtrate was added to the main solution.

The precipitation of barium sulphate in the presence of ferric iron was carried out according to the general method of Kuster and Thiel (*Z. an. Chem.*, 1899, xix, 99). The modifications of this method are given herewith.

The main solution was diluted to 300-350 ccs., warmed, and ammonium hydroxide (sp. gr. .94) was added in excess. A warm dilute solution of barium chloride was added slowly and with constant stirring, which was continued after the addition of the precipitant. Concentrated hydrochloric acid was added to just acid reaction and then two ccs. excess of acid for every 300 ccs. of solution. The resulting solution was kept hot for some time to allow the precipitate to settle and then filtered through a Gooch crucible. The barium sulphate was washed well with hot water acidulated with hydrochloric acid (two ccs. of concentrated acid per litre). On ignition the barium sulphate was pure white in every case.

Series 1.

Copper Absent.

Weight of Mineral	Sulphur
.3562 gm.	48.58 per cent.
.2705 ,,	48.45 ,, ,,
3549 ,,	48.35 ,, ,,
.3643 ,,	48.08 ,, ,,
.3683 ,,	47.93 ,, ,,
.3200 ,,	48.75 ,, ,,

Series 2.

Copper Present.

Weight of Mineral	Sulphur
.3539 gm.	42.09 per cent.
.3129 ,,	42.32 ,, ,,
.2560 ,,	43.00 ,, ,,

The variation in these results is due to the rapid alteration of the fine divided mineral by air oxidation.

(Dana, Textbook of Mineralogy, Third Edition, Wiley & Sons, 1922, p. 377; Clark, The Data of Geochemistry; Bulletin 770 U.S. Geological Survey, p. 888, and note to this reference; Cleveland Elementary Treatise on Mineralogy and Geology, First Edition, 1816, p. 478, *et. seq.*)

CHALCOPYRITE.

The carbon tetrachloride was not heated but was allowed to become warm. not over 40° C., from the radiation of the burners. The mineral was not heated for fifteen minutes as the gases started the reaction. The second fifteen minute period, the mineral was heated to 150-170° C. and then the temperature was increased so that the ferric chloride just sublimed out of the boat. During the last ten to fifteen minutes the temperature was raised to 420-430° C., so that a small part of the copper chloride sublimed. The mineral in the boat must not fuse. The time of decomposition was one hour.

The gangue and the remainder of the copper were in the boat, which were washed into a beaker and the solution acidulated with hydrochloric acid and warmed. All dissolved except the gangue, which was filtered off and if the mineral was argentiferous, the gangue was examined for silver chloride. The filtrate was added to the main solution.

Weight of Mineral	Sulphur
.3072 gm.	33.37 per cent.
.3025 ,,	33.39 ,, ,,
.3019 ,,	33.41 ,, ,,
.3044 ,,	33.34 ,, ,,
Average	33.38 ,, ,,

CINNABAR.

The mineral was warmed at 250-300° C. for ten to fifteen minutes so that the mercuric chloride just sublimed out of the boat. The temperature was slowly increased to 400-450° C. and the heating continued until nothing further volatilised. When the mineral was bituminous, the gangue was black. The time for decomposition was thirty-five to forty minutes.

Weight of Mineral	Sulphur
.5268 gm.	12.72 per cent.
.5837 ,,	12.57 ,, ,,
.5239 ,,	12.56 ,, ,,
.5819 ,,	12.57 ,, ,,
Average	12.61 ,, ,,

BISMUTHINITE.

The mineral was warmed at 200-250° C. for ten to fifteen minutes so that most of the bismuth chloride sublimed. The temperature was gradually raised to 450-500° C.

which removed all of the bismuth and part of the copper which was present in this sample. This mineral was mixed with cassiterite which was unaffected by this treatment. The time of decomposition was about forty minutes.

In order to properly adjust the acid concentration for the precipitation of barium sulphate, pure zinc was added to the main solution to remove the bismuth and copper. These metals were filtered off, the excess acid expelled and the barium sulphate precipitated in the usual manner.

Weight of Mineral	Sulphur
.5371 gm.	2.59 per cent.
.7860 ,,	2.44 ,, ,,
.9193 ,,	2.56 ,, ,,
.7401 ,,	2.48 ,, ,,
.9315 ,,	2.45 ,, ,,
Average	2.51 ,, ,,

THE ANALYSIS OF ARTIFICIAL SULPHIDES.
COPPER MATTE.

The conditions for the decomposition and the analysis of copper matte were identical with those described for the mineral chalcopyrite (*q.v.*).

Weight of Matte.	Sulphur.
.3068 gm.	22.22 per cent.
.3112 ,,	22.31 ,, ,,
.3122 ,,	22.32 ,, ,,
.3012 ,,	22.34 ,, ,,
Average	22.30 ,, ,,

NICKEL MATTE.

The sample was heated for fifteen minutes at 300-350° C. after which the temperature was increased to 480-510° C. and kept there for about twenty minutes. The time of decomposition was forty minutes. All of the chlorides of iron, arsenic, and antimony and part of the copper and nickel sublimed out of the boat. The chlorides of cobalt, silver, and lead, the remainder of the copper and nickel, and the gangue remained in the boat. The soluble residue in the boat dissolved readily in warm very dilute hydrochloric acid. It was not advisable to add this filtrate to the main solution until after the sulphur had been precipitated as barium sulphate. The precipitation and removal of barium sulphate was carried out as directed under pyrite (*q.v.*).

Weight of Matte.	Sulphur.
.5788 gm.	7.05 per cent.
.5527 ,,	6.96 ,, ,,
.4710 ,,	7.01 ,, ,,
.4571 ,,	7.01 ,, ,,
Average	7.01 ,, ,,

PALLADIUM SULPHIDE.

The palladium sulphide was prepared from pure palladammonium chloride by heating it in pure hydrogen sulphide, generated from hydrochloric acid and stibnite.

The artificial sulphide was heated for one hour and twenty minutes at a temperature of 550° C. almost all of the palladium chloride sublimed out of the boat at the end of this period. However it was necessary to continue heating for a twenty-minute period at 575-600° C. Under *no* circumstances at any time during the decomposition was the palladous chloride in the boat allowed to fuse. When this happened, the undecomposed sulphide was held in the fusel material and in this state it was practically impossible to sublime the chloride and effect complete decomposition. At the end of the two periods of heating, which must not be under one hour and thirty minutes for a two-tenths gram sample, the reaction was complete and the system was allowed to cool. At the end of this time all of the sulphide was decomposed and there was no need to sublime all of the palladium chloride from the boat. All o fthe palladium chloride remained in the tube and boat. The main solution was analysed for its sulphur content.

Weight of Sample.	Sulphur
.2011 gm.	23.09 per cent.
.2027 ,,	23.19 ,, ,,
Average	23.14 ,, ,,
Calculated ...	23.10 ,, ,,

THE GENERAL PROCEDURE FOR THE ANALYSIS OF SELENIDES.

The apparatus used for the decomposition and analysis of the selenides was essentially the same as that described for the sulphides. Only one absorber was used and this contained 60 ccs. of 1 : 1 hydrochloride acid. Tests were made with several absorbers and with different absorbing materials but no trace of selenium was found beyond the first bottle.

The mineral was decomposed in the same general manner as the sulphide minerals. The volatile material was washed into the beaker which contained the washings of the absorber. This solution was boiled to reduce the selenic acid to selenious acid after which it was diluted to 250 ccs. and the selenium precipitated with sulphur dioxide. The solution was boiled to convert the selenium to the black avriety, which was filtered on a Gooch crucible, washed well with water and then with alcohol, dried at 105° C. and weighed. In all other re spects

the apparatus and the procedure were the same as reported for the sulphides.

Berzelianite in Calcite.

The mineral was not heated for the first ten minutes, in order that the hot gases might start the reaction. The second ten minute period the temperature was gradually raised to 250-300° C., and finally to 375-425° C. to complete the reaction. The total time required was about forty minutes. The gradual increase in temperature was necessary because the material was disseminated through calcite which tended to retard the decomposition.

Weight of Mineral.	Selenium.
.2520 gr.	3.09 per cent.
.2512 ,,	3.14 ,, ,,
.2616 ,,	3.13 ,, ,,
.3024 ,,	3.17 ,, ,,
Average	3.13 ,, ,,

Zorgite.

The mineral was heated at 200° C. for ten to fifteen minutes after which the temperature was increased to 400-450° C. for fifteen to twenty minutes. The boat contained the gangue, the silver chloride, and the major portion of the copper chloride:

Weight of Mineral	Selenium
.3743 gm.	28.33 per cent.
.2577 ,,	28.29 ,, ,,
.2911 ,,	28.44 ,, ,,
.2579 ,,	28.42 ,, ,,
Average	28.37 ,, ,,

The Procedure for the Analysis of a Telluride.

Altaite in Calcite.

The procedure for the decomposition and the analysis of this mineral was the same as for the selenides except that the burner at K was not used and the absorbing material was 60 ccs. o f1 : 4 hydrochloric acid.

The mineral was heated for thirty minutes at 250-275° C. The ovlatile material in the decomposition tube was washed into the main solution with 1 : 5 hydrochloric acid. The solution was boiled to reduce the telluric acid to tellurous acid, dilute to 250 ccs. and the tellurium precipitated with sulphur dioxide. The precipitate was filtered on a Gooch crucible, washed well with water and then with alcohol, dried at 105° C. and weighed. The lead chloride and the calcite remained in the boat; part of the latter was changed to chloride.

Weight of Mineral	Tellurium
.3567 gm.	4.48 per cent.
.3106 ,,	4.57 ,, ,,
.3378 ,,	4.53 ,, ,,
Average	4.53 ,, ,,

The minerals pyrrhotite, marcaste, arsenopyrite, stibnite, tetrahedrite, cobaltite, molybdenite, galena, enargite, sylvanite, and tiemannite were completely decomposed when heated in an air carbon tetrachloride vapour mixture, but no quantitative measurements for their sulphur, selenium, or tellurium content.

Summary.

1. A method for the detection and removal of sulphur compounds in "sulphur free" carbon tetrachloride is described.

2. A mixture of air and carbon tetrachloride vapour is shown to be an efficient and convenient reagent for the decomposition and chlorination of natural and artificial sulphides at elevated temperatures.

3. The decomposition and chlorination of selenides and tellurides may be accomplished by heating them in a stream of air and carbon tetrachloride vapour.

4. A method is described for the removal of sulphates from hydrogen peroxide.

5. A simple procedure is given for the introduction of bromine into hydrochloric acid to prevent contamination from the impurities in it.

The author wishes to express his sincere appreciation to Dr. H. S. Lukens under whose direction this inevstigation was conducted, and to Dr. D. L. Wallace for his encouragement and suggestions.

Philadelphia, Pennsylvania.

AGE OF CHEMISTRY COMING.

The eighth annual dinner of the London section of the British Association of Chemists was held at Les Gobelins Restaurant, Regent Street, on February 23. Miss Winifred Wright, chairman of the section, presided.

Lord Riddell, responding to the toast of "The Guests," submitted by Mr. E. R. Redgrove, said it might be imagined from what one read that there were no British scientists and that all the real discoveries came from America and France. That was not true. The misconception was largely due to the fact that we did not advertise ourselves. The least that could be done was to let the world know that this country was still

producing as great scientists as in the past. In proportion to population this country had probably produced many more distinguished men who had made great discoveries than any other nation had done. Unless a great nation like ours took care to carry its scientific, manufacturing, and commercial flag high throughout the world, it would lose in the race which was now taking place between all great countries.

Dr. E. F. Armstrong, proposing the toast of "The Association," said that in arranging their chemical knowledge they must have regard to the point of view of the other man who sought their assistance. Chemists to-day did not make as much use as they might of the information and knowledge they possessed. It was almost disheartening to him to find, on going through applications for appointments, how many chemists were unable in their applications to make any show of their abilities and attainments. There was no profession which had a greater future and a greater task before it than that of chemistry. During the last few years they had come into their own, but they were only at the threshold of what was to be a chemical age. There were not nearly enough chemists now to meet the demands which would come on the profession.

Mr. H. T. F. Rhodes, assistant secretary to the Society of Chemical Industry, and Mr. S. R. Price responded. The toast of "Kindred Societies" was submitted by Mr. C. S. Garland and asknowledged by Mr. James Stewart and Mr. E. R. Bolton.

TWELFTH EXPOSITION OF CHEMICAL INDUSTRIES, NEW YORK.

The Twelfth Exposition of Chemical Industries which will open at the Grand Central Palace, New York City, May 6 to 11, bringing together thousands of chemists, chemical and research engineers, manufacturers and buyers from forty odd industries is particularly significant of the advancement made in the chemical industries field duriug the last quarter of a century.

The various groups of this important industry as represented at the Exposition will exhibit the most modern equipment and advanced practices of chemical engineering and chemistry. A cross section of the metals group shows fifteen exhibitors who will show various alloys and include such outstanding producers as Crucible Steel, Vanadium Steel, International Nickel, Duriron, Inert Metal Products, Inc., Industrial Welded Products Co., Carpenter Steel Co., Globe Steel Tube Co., Titusville Forge Co., Nelson Metzler Corp., Lalance-Grosjean Mfg. Co., Ludlum Steel Co., Central Alloys Steel Co., Babcock and Wilcox Tube Co., and Fansteel Products Co. For the first time there will be exhibited a new acid-resisting alloy by Krupp. This metal has many special and unusual features that will be of great interest to the Chemical Industry. Considerable research and new development work has been undertaken during the past year in perfecting special alloys. The latest discoveries in this field will be presented in attractive displays by foremost manufacturers in this field of endeavour.

In the Laboratory Supply and Equipment group a large number of interesting exhibits will be assembled; exhibits of laboratory furniture; general laboratory apparatus and supplies; special laboratory equipment; filter papers; optical instruments; laboratory chemicals; platinum ware; instruments of precision; electrical apparatus; laboratory balances; glassware, porcelain, silica ware and plastic compositions. This group will have in its various exhibits complete displays, charts and graphs of all equipment and the functions it is designed to perform.

The Instruments of Precision group will have a number of exhibits, among which will be an exhibit of a spectro-photometer and hydrogen ion colorimeter. These two will be of particular interest to the colour and dye industry. The hydrogen ion colorimeter is new and will be exhibited at the Exposition for the first time. A number of balances, microscopes, high temperature furnaces and colour analysing apparatus will also be exhibited. A new method of connecting vitreosil pipe lines will be presented at the coming Exposition.

Attendance at the Chemical Industries Exposition is confined almost entirely to users and buyers of chemical equipment. Admission is gained only by invitation and registration. There are no tickets sold. To the last Exposition there came 67,000 men looking for ideas and information to aid them in the conduct of their business. This picked group of interested visitors came from 810 cities and towns in 40 States and 119 cities and towns in 39 foreign countries.

It might be interesting to note that of the 40 industries which are dependent in their operations upon a chemical change in the nature of the material, or are under chemical control, 20 of them produce 17 per cent. of all the products manufactured in the United States and employ 22.6 per cent. of

the capital invested in manufacturing, producing eight billion dollars worth of finished products. Is it any wonder that the world depends on the chemist and chemical industry for its advancement? Whether in peace or war the chemical industry is the foundation for progress and development of every other industry in the United States. As consumers of power the Chemical Industries rank first in coal consumption and second in the use of electrical energy.

GENERAL NOTES.

OVERSEAS TRADE.

The Commercial Secretary at Bucharest (Mr. R. J. E. Humphreys) reports that the Roumanian Ministry of War (Aviation Department) is calling for tenders, to be presented in Bucharest by the 14 March for the supply of castor oil and benzol.

Firms desirous of offering supplies of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 5129 should be quoted.

CORRESPONDENCE WITH OVERSEAS OFFICERS OF THE DEPARTMENT OF OVERSEAS TRADE.

Before initiating correspondence on commercial matters with overseas officers of the Department of Overseas Trade, which controls the commercial actiivties of the Commercial, Diplomatic, Consular, and His Majesty's Trade Commissioner services, British firms should bear in mind that the Department of Overseas Trade may have at its headquarters at 35, Old Queen Street, S.W.1., the information which they require or may have helpful advice to offer on the matter about which they contemplate correspondence.

THE CANADIAN DISTILLING INDUSTRY.

The Dominion Bureau of Statistics at Ottawa has forwarded to the High Commissioner for Canada in London a Report on the Distilled Liquor Industry in Canada giving figures for the years 1926 and 1927.

The Report in question covers the operations of 15 intividual plants in 1926 and 17 in 1927, most of which were in Ontario and Quebec, though 3 were operating in British Columbia and 2 in Manitoba.

The total capitalisation of the distilleries in 1927 was $37,528,954, and the 1,401 employees earned wages and salaries aggregating $1,895,084.

Materials costing $6,351,698 were used, the gross value of products being $25,960,985. The total production of spirits in 1927 was 11,483,360 proof gallons, as compared with 7,318,320 proof gallons in 1926, an increase of 4,165,040 gallons, or 56.91 per cent. Potable spirits increased from 4,179,242 proof gallons in 1926 to 9,025,180 proof gallons in 1927, or 116 per cent., whilst the production of industrial and commercial alcohols fell from 3,139,278 gallons in 1926 to 2,458,180 gallons in 1927, or a percentage decrease of 21.7.

THE GYPSUM INDUSTRY IN CANADA IN 1928.

The production of gypsum in Canada has steadily grown and in 1928 it reached, according to preliminary figures, 1,100,000 tons valued at $3,500,000. There is an increasing demand for the products of this industry. Gypsum is mined or quarried in Nova Scotia, New Brunswick, Ontario, Manitoba, and British Columbia, and in each of these provinces there are undeveloped deposits capable of furnishing additional high grade material when market conditions warrant their exploitation.

SAFEGUARDING OF KEY INDUSTRIES.

The Board of Trade announce that the Treasury have made an Order under Section 10(5) of the Finance Act, 1926, exempting phenetidine, para; and potassium ethylxanthogenate (potassium xanthogenate) from Key Industry duty from 4 March to 31 December, 1929.

The Treasury Order will shortly be published by the Stationery Office.

RADIUM COMPOUNDS.

In the House of Commons on February 22, 1929, Mr. W. Benn asked the Financial Secretary to the Treasury the total duty collected, since its imposition, on radium compounds; and whether he has any information as to the amount of radium and radium compounds at present in this country.

Mr. Samuel: From 1 October, 1921, to 14 January, 1927, duty was chargeable on

the following radium compounds only, *viz.*, radium bromide and radium barium chloride. The duty recorded as collected on these substances from 1 January, 1922, to 14 January, 1927, was £6. The figures for 1 October, 1921, to 31 December, 1921, are not available. From 15 January, 1927, duty became chargeable on all radium compounds, and the amount of duty recorded as collected for the period 15 January, 1927, to 14 May, 1928, when the duty was suspended, was £80. As regards the second part of the Question, I would refer the hon. Member to the reply given on 24 January last by my right hon. Friend the Minister of Health to Questions on the subject of radium supplies by the hon. and gallant Member for Central Hull (Lieut.-Commander Kenworthy) and the hon. Member for North Tottenham (Mr. R. Morrison). I have no further information on the point.

NEW MINING REGULATIONS FOR WESTERN CANADA.

It may be recalled that, although negotiations are in progress for the transfer of natural resources in Manitoba and Alberta from Dominion to Provincial control, the regulations affecting prospecting, staking, development and mining of metals in western Canada are at present issued by the Dominion Department of the Interior at Ottawa. These regulations have recently undergone radical changes, and the new Quartz Mining Regulations to become effective on April 1 next are expected to be of great advantage in the development of mining in the West. In addition to controlling metal mining activities in Manitoba, Saskatchewan, Alberta and the Northwest Territories, the Quartz Mining Regulations are effective in the Peace River block of British Columbia, where also the lands are under Dominion administration.

The most important feature in the new regulations from the prospector's point of view is the increase in the acreage which may be staked at any one time.

Miner's licenses are now required, as in Ontario and Quebec, thus eliminating the objectionable feature of the old regulations requiring staking for other parties under Powers-of-Attorney. The four-post system of staking now in force in the eastern Provinces of Canada is also adopted. The former system of centre-line staking with two posts necessarily involved many fractional claims and was a very serious hadicap to development.

A very decided impetus to development should be furnished by the elimination of the payment in lieu of assessment work and the substitution therefor of actual work on the ground. The work required to secure title is practically the same as in Ontario, two hundred days spread over five years. Title is still by lease as formerly and not by Crown grant, the leases exteuding for 21 years and are renewable.

Under the old regulations one of the most serious handicaps to development was the lack of facility for the registration of options on leases. The new regulations provide that unconditional assignments or options may be registered with the Department in the discretion of the Minister of the Interior. Provision is made for the formation, registration and revocation of mining partnerships.

A change very much desired by the mining industry was in the method of collecting royalties. Instead of collecting royalty on the gross production, provision is now made for the collection of royalties based on the net profits and amounting to three per cent. of annual profits over $10,000 and up to $1,000,000, five per cent. of the excess over $1,000,000 and up to $5,000,000 with an increase of one per cent. on each additional five million dollars.

Provision has been made throughout the new regulations for a system of thorough inspection and supervision by the staff of the Supervisory Mining Engineer of the Department of the Interior and the scale of fees for licenses, recording and registration have been thoroughly revised and are now practically the same as those of Ontario.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, February 21.

The following papers were read :—

Photochemical Equilibrium in Nitrogen Peroxide. Part II. The Dependence of Quantum Efficiency on Wave Length. By R. G. W. Norrish.

The quantum efficiency (γ of the photochemical reaction $2NO_2 \underset{\text{dark}}{\overset{\text{light}}{\rightleftarrows}} 2NO + O_2$ has

been investigated for six wave-lengths of the mercury vapour lamp in the visible and ultra-violet, using a photoelectric cell to measure light intensity. The following values were obtained : for 5760, 5460, 4360 A, $\gamma = 0.000$; for 4050 A, $\gamma = 0.74$; for 3650 A, $\gamma = 2.10$; and for 3160—2650 A, $\gamma = 2.07$. The photochemical threshold in the middle of the NO_2 absorption region noticed by Dickinson and Baxter has been found to be sharper than was originally supposed, their observation of slight photochemical activity of light of λ 4360 A, being definitely unconfirmed. No difference could be observed between the quantum efficiency of light of λ 3650 and λ3160 A; the values obtained indicated complete efficiency. The existence of fine structure in the NO_2 absorption spectrum is in agreement with the mechanism $NO_2 + h\nu = NO_2'$; $NO_2 + NO_2' = 2NO + O_2$ which is also confirmed by the kinetic observations.

Part III. A Comparison of the Thermal, Photochemical, and Electrical Decompositions, and a General Theory of the Change.

The thermal decomposition of nitrogen peroxide is an endothermic homogeneous bimolecular reaction, occurring with an absorption of 26,000 g.-cals. per $2NO_2$. The heat of activation at 300° Abs. is 32,600 g.-cals. per $2NO_2$ and the kinetics of the reaction are in full accord with Hinshelwood's theory of kinetic activation. It is indicated with reference to the data of the foregoing abstract that the absorption of blue light of λ 4360 A excites the molecule to the extent of 64,000 g.-cals.—at least double the energy required for its "thermal" decomposition—without any reaction occurring. If this absorbed energy were directly degraded to heat by a collision of the second kind, sufficient kinetic energy would be set free to bring about the decomposition of the colliding molecules. On this basis it is argued that the amount of molecular kinetic energy set free is limited and that the balance of energy should appear as fluorescence radiation. In the case of violet light of λ 4050 A, which shows an incomplete chemical activity, it is further argued that the 26,000 g.-cals. required for decomposition is only liberated to the molecular vibrational degree of freedom under certain specified conditions, the probability of which is indicated by the quantum efficiency. Under these conditions no fluorescence is possible since the NO_2 molecule is destroyed before it can radiate and the excess energy is removed by the products of reaction. Under alternative conditions, however, the molecule will not decompose and a restricted fluorescence should be visible. In the case of light of wave-length shorter than 3650 A, the activation of the molecular degree of vibrational freedom in all cases exceeds 26,000 g.-cals.; photochemical activity is therefore complete and fluorescence should be totally absent. The fluorescence predicted on the basis of the above views should, unlike that of iodine vapour, persist up to high pressures, and the order of its wave-length is suggested. It is shown that light corresponding with the predicted fluorescent region is emitted by nitrogen peroxide under the influence of electron bombardment in the discharge tube when decomposition to nitric oxide and oxygen occurs.

Part IV. Fluorescence and Photochemical Activity.

The fluorescence predicted by the foregoing photochemical theory has been detected, and the conditions for its production are described. In all respects the indications of the theory are confirmed. The fluorescence extends from pressures where the colour of the gas is hardly perceptible up to pressures of 20-30 mm., when it shows no signs of abating. It is destroyed by adding dry air at atmospheric pressure. No fluorescence is excited by green light of 5460 A; in blue light of 4360 A, two colours at least—an orange and a green—are excited, which with the help of selective viewing filters are found to be between the wave-length limits Ca 6400-550 A. In the fluorescence stimulated by violet light the orange is completely absent, and only the green remains, whilst with ultra-violet light of λ 3650 A, no fluorescence of any kind is detectable. Rise of temperature to about 300° diminishes the fluorescence excited by both blue and violet light, and in the former case the ratio of orange to green is apparently increased.

The Reaction of Nitrosulphonyl Chlorides. Part I. The Reaction of Hydrazine Hydrate with o-Nitrosulphonyl Chlorides. **By A. T. Dunn and W. Davies.**

The reaction between warm hydrazine hydrate and 2-chloro-5-nitro-p-toluenesulphonyl chloride is :—

$$2R.SO_2Cl + 2NH_2.NH_2,H_2O = 2R.SO_2H + N_2 + 2H_2O + NH_2.NH_2,2HCl.$$

The equation is based on the isolation of the sulphinic acid in over 90 per cent. yield

and on the formation of the theoretical amount of nitrogen. When the reaction is carried out in the cold the primary hydrazide can sometimes be isolated. The above production of *o*-nitrobenzenesulphinic acids is successful with the parent substance, and seems to be a general reaction, unless the sulphinic acid itself should be too unstable. Thus, all attempts at preparing 6-chloro-3-nitro-*o*-toluenesulphinic acid resulted in the formation of 2-chloro-5-nitrotoluene and sulphur dioxide. The same compound is obtained by the decomposition on the water bath of 2-chloro-5-nitro-*p*-toluenesulphinic acid, and *o*-nitrosulphinic acids lose sulphur dioxide very much more easily than sulphinic acids containing no nitroxyl group. The reaction between *o*- and *p*-nitrobenzoyl chlorides is normal, both primary and secondary hydrazides being formed. Only the primary hydrazides have been detected in the case of the *o*-nitrosulphonyl chlorides.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Mosuke Hayashi : " New Isomerism of Halogeno-hydroxy-benzoyl-toluic Acids. V. 3(6 ?) - Methyl - 2 - (4′ - chloro-2′-hydroxyl benzoyl)-benzoic Acid. 3(6 ?)-Methyl-2-(2′-chloro - 4′ - hydroxy - benzoyl) - benzoic Acid.

Mosuke Hayashi : " New Isomerism of Halogeno-hydroxy-benzoyl-toluic Acids. VI. 3(6 ?) - Methyl-2-(2′ : 5′-dihydroxy-benzoyl) -benzoic Acid.

Mosuke Hayashi : " New Isomerism of Halogeno - hydroxyl - benzoyl - toluic Acids. VII. Attempt to determine the Constitutions of 3(6 ?)-and 6(3 ?)-Methyl-2-(5′-chloro -2′-hydroxy-benzoyl)-benzoic Acid."

Satoy su Iimori : " Examination of Separation of Thorium by Means of a Radioactive Indicator."

Soai Tanaka : " Derivatives of Anthraquinone."

Giichiro Fuseya, Kumazo Sasaki and Masataka Nagano : "Viscosity of Dilute Aqueous Solutions of Ash-free Gelatine."

Tessaku Ikeda and Yasuji Fujita : " Essential Oils of *Cunninghamia* Konishi Hayata."

COLLECTION OF CZECHOSLOVAK CHEMICAL COMMUNICATIONS.

The first two numbers of the Collection of Czechoslovak Chemical Communications, and a new monthly journal published in Prague at 170 kc (26 Swiss francs, or £1 to English subscribers), contain articles embracing the whole subject of pure chemistry.

In the January, 1929, issue there are the following :—

On the Complex Oxalates of Scandium. By Prof. J. Sterba - Böhm and S. Skramovsky.

The Deposition of Radium and Other Alkaline Earth Metals at the Dropping Mercury Cathode. By J. Heyrovsky and S. Berezicky.

Rhamnoconvolvulic Acid. By E. Votocek and V. Prelog.

Those in the February issue are,

The Reaction of Cupric Salts with Thiosulphate. By J. Harris and V. Hovorka.

The Titration of Thallous Salts by Permanganate in Hydrochloric Acid Solutions. By A. Jilek and J. Lukas.

The Formation of Acid Lithium Aluminate. By V. Prociv.

On the Methylated Nitro-naphthylamines. By V. Vesely and A. Vojtech.

Alcoylated Pyrrolones. The Synthesis of Gamma-ketonic and Fatty Acids. By R. Lukes.

The journal, which is published in French and English, is intended to disseminate the discoveries and results of researches carried out in the laboratories of the Czechoslovak Universities and technical colleges. The editors are Dr. J. Heyrovsky, Prof. of Physical Chemistry, Charles University, Albertov, Prague; and Dr. E. Votocek, Prof. of Organic Chemistry, The Czech Polytechnical Institute, Trojanova 18, Prague.

NOTICES OF BOOKS.

Chemisches Fachwörterbuch (*Deutsch-Englisch-Franzosisch*). Compiled by A. W. Mayer. Vol. I. Pp. xii + 826. Leipzig : Otto Spamer. 1929. Price 75 marks.

Prof. Mayer deserves well of scientists for his exhaustive Chemical Dictionary, which will ultimately (in three volumes) cover all the chemical terms used in German, French and English together with their equivalents in the other two languages. It is common knowledge among scientists that even the better type of dictionaries is seldom adequate so far as technical terms are concerned and the bi-lingual dictionaries at present available frequently mislead the chemist who seeks the equivalent of an unfamiliar German or French expression. One special difficulty is that the same substance or instrument may have two or more names in each language and in this respect the present compiler has succeeded in giving these synonyms, including the (sometimes unscientific) "trade terms." In order to dispel any doubt, the chemical formula, or in the case of apparatus, a brief explanation, has been given in brackets (in this volume these are in German, in the two to follow they will be in English and then French).

For the convenience of English and French chemists who may use the dictionary German letters with the diaresis have been treated as though it was not there, *e.g.*, äthan (ethane) follows athamantin. Further, abbreviations have been reduced to about twenty readily recognisable ones.

In his tri-lingual preface the author writes :— "Like every other first edition this will probably also contain shortcomings and I shall deem it a great service to have any such pointed out to me." He acknowledges indebtedness to a gentleman who desires to remain unknown who undertook to correct the text from the scientific point of view.

Chemisches Fachwörterbuch, covering as it does scientific, technical and industrial terms, deserves a place on the shelves of all reference libraries.

J. G. F. Druce.

Applied Chemistry. (A Practical Handbook of Household Science and Public Health.) By C. Kenneth Tinkler, D.Sc., F.I.C. (Prof. of Chemistry in the University of London), and Helen Masters, B.Sc. Vol. I., Water, Detergents, Textiles, Fuels, etc. Pp. xii + 296. Second Edition, Med. 8vo, with 84 illustrations. Price 15s. net. Crosby, Lockwood & Sons, 7, Stationers' Hall Court, London, E.C.4.

This is a practical and useful book, one of the large number of valuable technical works published by the publishers. Its importance is in part testified by the fact that the present is a second edition, in the preface to which the authors say that the preparation of the second edition has given them the opportunity to make certain additions and alterations, especially in reference to articia lfibres, bleaching agents, etc. These, of course, make this edition more valuable than the first. The scope of the work will be understood from the subject matter elaborated from the ten chapters on water analysis, water softening and soda substitutes, soap, textile fibres, bleaching agents, dry cleaning, air analysis, gaseous fuels, liquid and solid fuels, material used for the protection of wood, metal and other substitutes. The various formulæ are clearly set out and the illustrations are helpful in the interpretation of the analyses given in the various chapters. A usefu ldetailed index and list of books of reference are appended.

Chemistry in Daily Life. By S. Glasstone, D.Sc., Ph.D., F.I.C., Lecturer in Chemistry in the University of Sheffield. Pp. 250. 6s. net. London : Methuen & Co., Ltd., 36, Essex Etreet, W.C.2.

This well-written book might well be called Science Simplified, for as far as we can see, while it can be usefully perused as a refresher by scietifically trained readers, there is no part so abstruse as to be beyond the comprehension of the intelligent man or woman without any special chemical training. It is also interesting as it deals in simple language with such subjects as the beginning of chemistry, the structure of matter, the air and its gases, water and hydrogen, etc. It thus appeals to a much wider circle than the book which is "Greek" to all except those specially trained in science. The modset price, too, makes for a large circulation.

PUBLICATIONS RECEIVED.

The Commonwealth of Australia Council for Scientific and Industrial Research have issued *Bulletin* 38, *The Chemical Composition of Wool* (with special reference to the Protein of Wool Fibre-Keratin) by Hedley R. Marston, and *Bulletin* 39, *The Utilisation of Sulphur by Animals* (with special reference to Wool Production), by Hedley R. Marston and Prof. T. Brailsford Robertson, D.Sc.

U.S. BUREAU OF STANDARDS.

Department of Commerce.

Present Home Financing Methods. By John M. Gries and Thomas Curran. 5 cents.

Carbon Brushes and Brush Shunts, Simplified Practice Recommendation, R 56-28. 10 cents.

Composition Books, R 84-28. 5 cents.

Hack-Saw Blades, R90-28, 5 cents.

Forthcoming Events.

ROYAL INSTITUTION.

Friday, March 8, at 9 p.m.—Prof. T. F. Tout : "The Place of Women in Later Mediæval Civilisation."

Saturday, March 9, at 3 p.m.—Sir Ernest Rutherford : "Molecular Motions in Rarefied Gases."

Tuesday, March 12, at 51.5 p.m.—Dr. W. Kemp : "Antarctic Whaling Expeditions."

Thursday, March 14, at 5.15 p.m.—Rev. Wm. H. Draper : "The Handling and Interpretation of Metaphor."

Friday, March 15, at 9 p.m.—Prof. V. M. Goldschmidt : "The Distribution of the Chemical Elements."

Saturday, March 16, at 3 p.m.—Sir Ernest Rutherford : "Molecular Motions in Rarefied Gases."

ROYAL SOCIETY OF ARTS.

Wednesday, March 13, at 8 p.m.—(Ordinary Meeting). R. P. G. Denman, A.M.I.E.E. : "Loud Speakers." William H. Eccles, D.Sc., F.R.S., will preside.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

At the Royal Society of Arts, John Stieet, Adelphi, W.C., on Tuesday, March 12, at 5.30 p.m.—The following paper will be read by A. E. Chambers, A.M.Inst.C.E., M.Inst.P.T. : "Drilling for Oil with a Diamond Drill." By G. Heseldin, M.Sc., A.M.Inst.C.E., A.M.Inst.P.T.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

4,711.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges).—Manufacture of 1-halogen2-amino-naphthalene sulphonic acids. February 12th.

4,513.—Commercial Solvents Corporation.—Process for preparing normal butyl alcohol, etc. February 11th.

5,050.—Fong, Y. S.—Manufacture of sodium glutamate. February 14th.

5,097.—Friederich, W.—Manufacture of nitrous oxide. February 15th.

5,017.—Poore, P.—Production of acetic acid, etc. February 14th.

Specifications Published.

305,599.—Gareau, N. J.—Production of alumina, sodium carbonate, and hydrochloric acid.

305,816.—Ewan, T.— and Imperial Chemical Industries, Ltd.—Catalyst for the production of hydrocyanic acid.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

303,243.—Dyes.—Imperial Chemical Industries, Ltd., Nobel House, Buckingham Gate, London, and Allchin, L. J., Crumpsall Vale Chemical Works, Blackley, Manchester.

Hydroxyphenyl rhodamines and their sulphonic acids.—A 3 : 6-dichlorfluoran is condensed with an *o*-, *m*-, or p-aminophenol, or a phthalic anhydride is condensed with a di-(hydroxyphenyl)amine in which one hydroxy group is in the *m*- position. The basic dyes so obtained may be sulphonated. In examples : 3 : 6-dichlorfluoran is condensed with p-amino-phenol and the product sulphonated ; the use of o-aminophenol, 5-amino-o-cresol, and $3^1 : 6^1 : 3^1 : 4^1 : 5^1 : 6^1$-hexachlorflouran is mentioned ; $3 : 4^1$-dihydroxydiphenylamine is condensed with phthalic anhydride and the product sulphonated ; the dye in this case is accompanied by an acridine derivative, which may be partly removed by careful salting out of a solution of the sulphonated dye in alkali.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

MANETOL.

498,214.—Chemical substances prepared for use in medicine and pharmacy.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. February 20th.

HOZONTENE.

499,180.—Chemical substances prepared for use in medicine and pharmacy.—Hough, Hoseason & Co., Limited., Sun Buildings, Bridge Street, Manchester. February 20th.

STANIPHUR.

498,105.—Chemica lsubstances prepared for use in medicine and pharmacy.—Whiffin & Sons, Limited, 18 to 28, Lombard Road, Battersea, London, S.W .11. February 20th.

VITAPHYLL.

498,910.—Chemical substances prepared for use in medicine and pharmacy.—Chlorosan actien Gesellschaft Chemische-Therapeutische Praparate, im Bruhl 943, Zofingen, Switzerland. February 20th.

WITHERIT.

Tender wanted for 15 tons del. cif. Hamburg. Offer, A. P. W., 22 Ala-Haasenstein u. Vogler, Berlin W35.

FIRM OF TENT MANUFACTURERS require assistance (by correspondence) in waterproofing of Canvas.—Box No. 24, c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

" EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News*.
Price 5s.

PERIODICALS FOR SALE.

Advertiser has a stock of back numbers of *Scientific Periodicals* which he is willing to sell at one-third published price, or less. Typed list sent on receipt of 1½d. stamp.—Write, G. D., c/o *Chemical News* Offices.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.

Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : Merton House, Salisbury Sq.. London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE"
Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
16, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3596.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Magnetism 161
By F. H. Loring.
The Modification of Baeyer's Strain Theory 164
By E. E. Ayling, M.Sc.
The Four Component System in Peace and War 166
Barcelona International Exhibition 167
On the Distribution of Quinine in the Blood 167
By O. S. Gibbs, M.B., Ch.B.
Science of Keeping Fit 168
Detection of Carbon Monoxide in Mines 169
General Notes 170
Proceedings & Notices of Societies :—
The Chemical Society 171
Institute of Chemistry of Great Britain and Ireland 172
The Physical Society 173
Society of Public Analysts 174
Notices of Books 174
Forthcoming Events 175
New Patents 175
New Trade Marks 176

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 28/- net.

MAGNETISM.

By F. H. LORING.

A great deal is known about *applied magnetism*, as designers of electrical apparatus will testify; and much is known about *magnetic phenomena* which come within the range of pure science, *i.e.*, not applied science.

Many attempts have been made to reduce magnetic phenomena to the small-scale behaviour of negative electrons. Honda's recent theory is perhaps one of the most successful efforts in this respect. Honda's theory is fully described in this Journal of December 7, 1928, vol. 137, p. 353.

In an article I wrote (published in 1924) I attempted to visualise the behaviour of electrons particularly in the case of ferromagnetic substances like iron, where the magnetic phenomenon is most strongly exhibited. Quoting my own words I said :—

"From the foregoing studies, in particular the periodic scheme, . . . it is of interest to consider magnetism as a phenomenon involving the proper circulation of electrons in atomic or sub-atomic spaces, as discussed below.

"An introduction to this development of the subject calls for a brief statement of the present views, which reduces to the fact that no comprehensive theory of magnetism has been established. Many more or less successful excursions into this field of research have been made. Considering the Weber, Ewing(-Warburg) and the Langevin theories, the classical experiments of Ewing and his later theoretical views, and those of Honda and others, these no doubt represent a considerable modicum of truth. At any rate the present-day views seem to be centred round the idea that the atom as such and by itself is not wholly responsible for the highly magnetic properties of iron, to take an example.

"This means that the magnetic properties of the atom [taken collectively] are not such as to be carried unchanged through atomic combinations. Iron is highly magnetizable, while chemical compounds of iron, or even certain oxides of iron, are feebly magnetic in comparison. Indeed, some compounds are diamagnetic.

"It is probable that the strongly magnetic properties of such metals as iron, cobalt, nickel, depend upon certain atomic configurations, or configurations of atoms to be more precise; but these have their

basis in the particular atom concerned. It can be said that Group VIII, containing 9 elements, is on the whole a magnetic one, for elements displaying the strongest magnetic properties occur in this group. Group III in respect of its rare-earth series of 13 elements is also fairly magnetic in some of its oxides, Dy_2O_3 being one of the strongest, if not *the* strongest, magnetic substance outside certain pure metals of Group VIII, and apart from the Heusler alloys . . .

"Here is a case of the magnetic properties being maintained or enhanced by the presence of combined oxygen, for the pure rare-earth metals may not have appreciably higher susceptibilities than their oxides, even if they are as high. The direct inference is that certain atomic associations or atomic combinations must exist if strongly magnetic susceptibility is to be obtained. In this way the phenomenon seems to devolve upon a certain association of atoms being present in the substance, but the nature of the atoms must be taken into account.

"If it be assumed that the electrons present in the substance must be free to describe orbits and that they have, or take up, the proper orientation within its solid structure in order to get high magnetic susceptibility, then there must be proper room in the *electrical sense* for such orbits; *i.e.*, a certain freedom of movement must be possible. The substance need not be structurally extra porous, or even weak from the point of view of tensile strength. In fact steels are highly magnetic and they have great strength.

"In studying the periodic table . . . it will be seen that at iron a flat portion develops. This peculiarity seems to suggest that at iron the atom building stopped its normal course, and, instead, at this point the elements underwent an internal close fitting-in of new materials. This can be likened to the building of a large hotel, when, after erecting a strong steel framing the filling in with bricks becomes the final stage of structural operations. Bohr has developed practically the same idea in connection with the rare-earth elements and those of Group VIII. Such structures do not by the very nature of things involve a continuation of the structural building: the steelwork is finished.

"Having, however, worked out a sort of limit to normal building, the question arises, Why should . . . *iron of atomic number 26 be so powerfully magnetic when excited?*

"The answer seems in some way bound up with the filling-in process whereby a spacial zone is somehow produced when the atoms are in juxtaposition; and in this space the electrons are free to roam, or they are free to describe orbits without being captured or 'built-in' to adjacent atoms, or to adjacent structural parts. A *structural saturation* in the electrical sense is thus reached, but this must not be confused with valency saturation, as in the instance of the inert gases. These gases are feebly diamagnetic, and this suggests a modified condition. . .

"It is, from the analogy used here, as if the corridors were so designed that revolving electrons in them neutralised each other magnetically.

"Putting this idea in another way, and adhering to the same image, it is as if the steel structure when open became a trap for loose filling-in material, but if definitely filled in everywhere except in some main corridors, then an active agent, the electron, could roam at will round and round such closed passages, and these circulations would give rise to the magnetic field, just as a conductor carrying a current is essentially a tube of flowing electrons.

"The connection, thus sketched, is obvious, and the cause is apparently traceable to the atomic structure, very much as the valency of an element, though due to external electrons, has its controlling power centred in the nucleus; and to continue this digression one is here reminded of Prof. Soddy's neat phrasing as applied to the nuclear atom, for he said: 'The atom is an *imperium in imperio*, and like most such systems is very conservative and resistant to change. The electrons in the shell, that govern almost all the atomic properties, except mass and radio-activity, are in turn but the bureaucratic instruments of the real government, which is the intensely charged central nucleus. The transmutation of atoms, as social systems, is alike impossible because the apparent government is not the real government.'—*Royal Institution Lecture*, 1923.

"Returning to the subject, magnetism is then due both to internal and external structural conditions, while the conditions must be such as to permit of the electrons taking up proper circulatory motion."

In Honda's theory the above-described principle is included.

There is one feature, which, so far as I know has not been stressed, and that is

that the behaviour of the magnetic atom—or magnetic molecule, or magnetic group of molecules in mutual influence—*is primarily conditioned by a surface state*, if it may be so described. By a *surface state* I mean that externally the magnetic system or unit is, as it were, smooth and free from irregularities, so that the internal magnetic system can cause proper orientations as shown by Ewing's original model, so as to give rise to powerful additive effects, instanced in the case of iron. In other words, according to Honda's terminology, *the substance can be magnetised.*

In my note on " The Hydrogen Molecule and the Electron," this Journal (1929, 138, 116) I depicted a model of the H_2 molecule. As shown, such a molecule would be individnally a magnet—*i.e.*, possess a magnectic moment—if the theory of magnetism can be reduced to the vortex idea of the electron, this perhaps corresponding with the magneton; but in a gaseous state such asymmetrical molecules could hardly be expected to suffer proper orientations; and even in the liquid and solid states the asymmetrical feature would strongly interfere with the orientations, as realised in Ewing's original model, which is too well known to require description here.

If molecular hydrogen were reduced to the liquid state and then to the solid state in a powerful magnetic field, one would, at first flush, expect to get a strongly magnetic body like iron; but, to get the orientations—an all-one-way alignment of the molecules—might entail forces greater than or different from, those the magnetic field could possibly give rise to in connection with the molecular individuals, owing to the so-called surface irregularity or asymmetry above indicated.

Now oxygen is quite appreciably paramagnetic as compared with other paramagnetic substances.

On the view here stressed this may be due to a greater symmetry of the O_2 molecule (see concluding statements below).

Taking an extreme case, the iron molecule would be exceedingly symmetrical *externally*, and to all intents and purposes smooth and regular. The inert gases, for example, might even be more so, but their internal electron vortices are probably such as to reduce the over-all magnetic moment practically to zero, and they become diamagnetic in virtue of these counteracting vortices. Therefore, a diamagnetic substance is one that has internal neutralising or closed magnetic circuit electron vortices which locally usurp the field and interfere with the impressed normal magnetic field being fully established in the unit.

It is important to note that surface irregularity may not matter in cases where there is complete internal freedom, as atoms within atoms would afford ideal systems if the inner atoms were free to take up any position whereby their electron vortices were brought into magnetic alignment. Differential effects would have to be considered in any case, but enough has been said to show the possibilities here stressed.

It is of concluding interest, however, to note that from the specific heats of gases (see *Chemical News*, 1929, 138, 18; or, rather the references contained therein for details bearing on the statement to follow here) we know that the value of γ gives evidence as to the atom or molecule whirling as a whole on impact according to the kinetic theory; so that all-round symmetry is associated with non-rotation ($\gamma=1.656$, say), and the converse with rotation. The kinetic rotations would operate to make the orientations of a random type and prevent any magnetic effect. One can, perhaps, conclude from the foregoing that the ideally symmetrical inert gases derive their diamagnetic property from magnetically counteracting vortices, as stated above, which are within the atom, *i.e.*, not externally localised affairs. On the other hand, liquid or even solid oxygen being very appreciably paramagnetic suggests that the electron vortices are not so counteracting as are those of the inert gases, but that the oxygen molecule ($\gamma=1.40$) is not symmetrical enough (taken at all points) to give rise to a strong magnetic effect at all comparable with that of iron, even under the most favourable circumstances.

It will be understood that the use of the word *symmetrical* implies *all-round* symmetry in the ideal case, as of a *sphere*; indeed, any statements herein made should be taken in conjunction with the purport of this article as a whole, and it should be read along with Honda's article referred to above. There is no doubt a deeper significance in the special terms, I have introduced, than here indicated. For example, *surface irregularity* implies *dynamic* conditions and field influence.

The reader will observe that I have not taken into account any possible gyroscopic action, as Honda has done, but as I have developed only one phase of the subject the dynamics of rotation can remain in abeyance pending more information

(To be concluded.)

THE MODIFICATION OF BAEYER'S STRAIN THEORY.

By E. E. Ayling, M.Sc.
(University College, Swansea.)

The modification of Baeyer's Strain Theory which was proposed by Beesley, Ingold and Thorpe[1] is based on the hypothesis that the angles between the valencies of a Carbon atom are modified by the space requirements of the attached groups. This hypothesis was given a quantitative basis some years later by Ingold[2, 3], who derived expressions by means of which the angles between the carbon valencies can be calculated from the volumes of the substituent atoms or groups. Employing Traube's atomic volumes[4] for Carbon (9.9) and Hydrogen (3.1) the angles between the carbon-to-carbon valencies in secondary and tertiary carbon atoms were calculated as 115.3° and 112.5° respectively.

The expressions derived by Ingold have since been criticised by Short[5] who derived expressions which are based on the assumption that the angular space between the domains of each pair of attached atoms subtended at the centre of the central Carbon atom is the same. The use of Traube's atomic volumes is also criticised and, by employing the new expressions and the atomic volumes of Le Bas[6] (C, 14.8; H, 3.7), Short obtains values of 116.6° and 113.0° respectively for the above two angles.

Short's criticism of Ingold's formulæ and of the method of deriving them loses some of its validity since he has not shown that his own expressions give different results from those of Ingold when the same atomic volumes are used for each. The new values which Short obtains might equally well be due to the use of different atomic volumes.

A. $2\phi \longrightarrow \overset{R}{\underset{C}{>}}C\overset{C}{\underset{C}{<}} \longleftarrow 2\theta$

In the case of the angle, 2θ, between the carbon-to-carbon valencies in the Carbon atom A, it is obvious that the different values obtained by Ingold and by Short are due entirely to the use of different atomic volumes, since the expression derived by Short is identical with the second of the pair of equations given by Ingold[3], *i.e.*,

$$2 \sin \theta = \sqrt{3} \sin 2\phi,$$

from which he obtains the expression for the calculation of the angle. The expression given by Short is :—

$$\sin (\alpha + t) = \sin 60^\circ \sin (\alpha + \beta + 2t),$$

α and β being the angles subtended at the centre of the central Carbon atom by the radii of the atomic spheres of Carbon and the radical R respectively, and 2t the inner tangent angle between each pair of substituents. The angle 2θ is stated by Short to equal $\alpha' + \beta + 2t$, but this is obviously a mistake since it is the angle between the carbon-to-carbon valencies and must be $2\alpha + 2t$, and the values for the angles given by Short agree with this. The angles $(\alpha + t)$ and $(\alpha + \beta + 2t)$ correspond to the angles θ and 2ϕ respectively and sin 60° is $(\sqrt{3})/2$, so that Short's expression reduces to the equation of Ingold's given above. The expression given by Short exhibits, therefore, no advance from the expression derived by Ingold and both expressions should yield the same values for the angle 2θ, provided that the same atomic volumes are used for each. Employing Ingold's expression with the volumes of Le Bas, the angle obtained is 113° 4′, agreeing with that given by Short. Conversely, Short's expression with Traube's volumes gives the angle 112° 27′, whereas Ingold's expression gives 112° 28′.

B. $\overset{R}{\underset{R}{>}}C\overset{C}{\underset{C}{<}} \longleftarrow 2\theta$

For the calculation of the angle in the case of the Carbon atom B, the expression deduced by Short[5] does not appear to be identical with either of the equations or the final expression derived by Ingold[2], but the above results suggest that the angles obtained by means of either Short's or Ingold's expressions should agree when the same atomic volumes are used. Ingold's expression has been given in a simplified form by Ingold, Sako and Thorpe[7], but their formula can be still further simplified, when it becomes

$$\operatorname{cosec} \theta = 1 + \rho / [1 + \sqrt{(6\rho)} + \rho]$$

which is comparable with the simplified form given by Short, ρ being the ratio of the cube root of the atomic volume of R to that of C, that is, proportional to the ratio of the respective atomic radii. (It should be noted here that Ingold, Sako and Thorpe state that ρ is the ratio of the atomic volume of R to that of C, but this is obviously a slip, since comparison of the original with their simplified expression shows that the cube root ratio is intended.)

If Ingold's expression for the secondary carbon atom be employed in conjunction with the atomic volumes of Le Bas, the angle obtained is 116.5°, agreeing with that obtained by Short. On the other hand, using Short's expression and Traube's volumes the resulting angle is 115.5°, which is in close agreement with Ingold's value. These results show that in this case also the increase in the angle found by Short is due entirely to the different atomic volumes

and not to the new expression which he derived.

To test this conclusion further, the angles between the carbon-to-carbon valencies in the Carhon atoms A and B have been calculated for the cases in which R is either Fluorine, Chlorine or Bromine. Both Ingold's and Short's expressions have been used together with the two values for the atomic volumes, which are :— Traube[8], F, 5.5; Cl, 13.2; Br, 17.7. Le Bas[9], F, 8.7; Cl, 22.1; Br, 27.0. The results obtained are embodied in the Table, together with those given above, and it will be seen that the angles calculated by both expressions exhibit a remarkable agreement when the same atomic volumes are used, the maximum difference being less than 0.4 per cent.

TABLE I.

Angle between C-to-C valencies in	Traube atomic volumes Ingold's method °	Traube atomic volumes Short's method °	Le Bas atomic volumes Ingold's method °	Le Bas atomic volumes Short's method °
H C >C< C C	112.5	112.45	113.1	113.0
H C >C< H C	115.3	115.5	116.5	116.6
F C >C< C C	111.0	111.0	110.8	110.9
Cl C >C< C C	108.8	108.7	108.5	108.35
Br C >C< C C	108.1	107.8	108.0	107.8
F C >C< F C	112.4	112.6	112.1	112.3
Cl C >C< Cl C	108.0	107.85	107.5	107.2
Br C >C< Br C	106.6	106.2	106.5	106.1

The expressions derived by Short, therefore, do not afford a basis for the criticism of Ingold's expressions but rather afford an excellent confirmation of them. Starting from different premises, Short derives two expressions, one of which, that for the tertiary Carbon atom, is identical with one of the equations derived by Ingold, while the expression for the secondary Carbon atom yields results identical with those obtained from Ingold's expression.

The use of Le Bas' atomic volumes in the place of Traube's in calculating these valency angles appears to offer a distinct advantage. Traube's volumes are obtained from the densities of compounds determined at 15° and are regarded as based upon assumptions which are doubtful[10]. The volumes have also been used for the detection of association in a liquid[11] and the compounds cannot be regarded as having been studied under comparable physical conditions. The more modern atomic volumes of Le Bas, on the other hand, are based on the densities of compounds at the boiling point, which will give more comparable results.

The values preferred for the angles between the carbon-to-carbon valencies in the secondary and tertiary Carbon atoms are, therefore, those obtained when Le Bas' volumes are used. The use of Ingold's expressions appears to be the more desirable, since this gives uniformity with the third case studied by Ingold and Thorpe and their co-workers[1, 7], in which the Carbon atom is included in a polymethylene ring.

For the above two Carbon atoms, therefore, and for the corresponding cases with the halogens, the angles which seem most justifiable are those given in the third column of the Table, calculated by means of Ingold's expressions and the atomic volumes of Le Bas.

BIBLIOGRAPHY.

1 Beesley, Ingold and Thorpe, *J. Chem. Chem. Soc.*, 1915, CVII, 1080.

2 Ingold, *ibid.*, 1921, CXIX, 305.

3 Ingold, *ibid.*, 1922, CXXI, 2676.

4 Traube, *Ahren's Vortrage*, 1899, IV, 275.

5 Short, *Chem. News*, 1926, CXXXIII, 145.

6 Le Bas, *Molecular Volumes*, 1915, pp. 20-21.

7 Ingold Sako and Thorpe, *J. Chem. Soc.*, 1922, CXXI, 1178.

8 Traube, *loc. cit.*, 278.

9 Le Bas, *loc. cit.*, p. 74.

10 Le Bas, *loc. cit.*, pp. vii-viii; see also the same author, *The Chemical News*, 1907, XCV, 33, 257; 1908, XCVIII, 85; 1909, XCIX, 206; 1911, CIII, 263; CIV, 22, 151, 166, 187 and 199.

11 Traube, *Z. anorg. Chem.*, 1895, VIII, 338; *Ber.*, 1897, XXX, 265.

THE FOUR COMPONENT SYSTEM IN PEACE AND WAR.

Dr. F. A. Freeth, O.B.E., F.R.S., of Imperial Chemical Industries Limited, Honorary Lecturer in the Theory and Practice of Heterogeneous Equilibria at University College, London, gave his inaugural address on Friday, 1 March, on "The Four Component System in Peace and War."

In the course of his lecture Dr. Freeth pointed out that since the theories of heterogeneous equilibria deal with the inter-relationships of solids, liquids and gases, the subject was automatically of intense interest to all chemical manufacturers. The particular type of four component system with which the lecturer dealt was what is known as the reciprocal salt pair or as a double decomposition. One of the latest and best known examples of this was the conversion salt-petre process whereby potassium chloride and sodium nitrate are converted into potassium nitrate and sodium chloride. The lecturer developed the subject along the lines of one of the pioneers of the subject, a chemist named Meyerhoffer who published his paper about thirty years ago.

The method of representation, however, used to explain the original arguments was of the most modern and simplest type, namely that developed by Professor Janecke of the Technical High School, Hanover. The method of representation takes the form of a cube the base of which represents all the possible mixtures of the salts whilst water is plotted vertically. It was shown that considering the base of such a cube only, that is to say the relative proportions o fthe salts, such base could be considered as being divided into four areas each of which represented saturation with respect to one of the four salts under consideration.

It was shown that if by any means a solution could be obtained with an area representing saturation with respect to a particular salt, then generally speaking it would be possible to obtain that salt in a pure condition. The famous reciprocal salt pairs of commerce were then considered, particular attention being paid to the ammonia soda process which was developed in this country by the late Dr. Ludwig Mond, F.R.S., the father of Lord Melchett, the present Chairman of Imperial Chemical Industries.

Several other well-known working processes were also discussed notably that of the caustification of sodium carbonate by lime giving caustic soda. It was pointed out that all the above old commercial processes had been developed empirically and it would be generally found that current practice corresponded very closely with the optimum conditions predicted by a stringent theoretical treatment.

Reactions of this character had played a very important part in the Great War. Fixed nitrogen was essential for modern explosives both propellants and the high explosives used for bursting charges in shells. Up till the last war the main source of fixed nitrogen had been Chili nitre which on treatment of the sulphuric acid yielded nitric acid which could be converted into high explosives like tri-nitro-toluene, propellants such as cordite, and could by neutralisation with ammonia be made to yield ammonium nitrate. It was manifestly impossible even before the war for the Germans to hope to maintain open the long sea route to Chili. They, therefore, as a part of their preparations for war, developed the Haber and Ostwald processes. The Haber process makes ammonia using as raw materials coke, air and water. The Ostwald process by burning ammonia with a limited quantity of oxygen converts it into nitric acid. After these processes were once developed on a sufficiently large scale Germany was automatically independent of any outside supplies of fixed nitrogen.

The above two processes, however, more especially the Haber process required very considerable advances in technique. On the outbreak of war it soon became manifest that immense supplies of fixed nitrogen would be required by this country. The general staffs, both those of our enemies and our own, completely under-estimated the high explosive requirements of modern warfare. Even assuming that the productive capacity of this country making nitric acid on the old lines would have been sufficient, there was a shortage of toluene for the necessary quantity of T.N.T. had that explosive been exclusively used. It was speedily discovered that T.N.T. could be diluted with no less than four times its weight of ammonium nitrate without impairing the high explosive properties of the mixture. The supply of ammonium nitrate, therefore, became of vital importance. Lord Moulton, the director of Explosive Supply, was faced with the following dilemma. Should he attempt to erect Haber and Ostwald plants of the necessary size or should he attempt to make ammonium by double decomposition using Chili nitrate as his source of fixed nitrogen. He decided on the latter course for the very good reason

that he considered the enormous calls on technical men of every kind rendered it almost out of the question that it would have been possible at that time to have developed what was in this country an entirely novel process.

The double decomposition processes which were used in the war were three and it was noted in parenthesis that nearly all of them had been considered as technically impossible after practical trial.

These processes were :—

1. The ammonia soda reaction on sodium nitrate giving ammonium nitrate and sodium bicarbonate.

2. Conversion of the waste calcium chloride of the ordinary ammonia soda process into calcium nitrate by double decomposition with sodium nitrate and the subsequent decomposition of the calcium nitrate with ammonium carbonate yielding ammonium nitrate and calcium carbonate.

3. Double decomposition of sulphate of ammonia and sodium nitrate giving ammonium nitrate and sodium sulphate. This latter process after initial failure subsequently became successful.

The lecturer pointed out the reasons for the initial failure and for the final success. This process was worked on a very large scale in Great Britain and upon a still larger scale in the United States.

BARCELONA INTERNATIONAL EXHIBITION.

A special invitation is extended to British firms interested in Chemistry to become exhibitors at the International Exhibition, Barcelona, from May to December this year. This Exhibition is the most important international one held since the war.

Detailed arrangements are being undertaken by the township of Barcelona, which is defraying the expenses, amounting to about £5,000,000. The Exhibition has received the patronage of the King of Spain, and the Spanish Government is actively cooperating. A strong British Committee has been formed, including Sir Philip Cunliffe-Lister, President of the Board of Trade, Viscount Rothermere, Lord Kylsant, Lord Waring, Lord Riddell, Lord Melchett, Sir Charles Wakefield, Sir Arthur Balfour, Sir Arthur Balfour, Sir Auckland Geddes, Sir William P. Burton, Sir John F. Beale, and Mr. John Walter.

All the leading nations will be represented by exhibits. One section is to be given over entirely to the display of the products of British firms. The Spanish nation hope that the Exhibition will be the means of extending British commercial interests in Spain. In the opinion of Spanish business men, it is not sufficiently recognised in Great Britain how big a market there is in Spain for British exports, and what efforts other countries, notably France and Germany, are making to capture the field.

Spain is undertaking an ambitious programme of progressive modernisation, and with the help of her Government is developing her railways, irrigation, hydraulic and electrical power, harbours and docks. In the construction of her arterial roads for motor traffic she is spending alone many millions of pounds sterling.

Leading British firms, through the British Section Office of the Barcelona Exhibition, 42, Pall Mall, London, are exhibiting, and arrangements are being made, in addition, with the British Chamber of Commerce for Spain, and the Spanish office of the Federation of British Industries, to put exhibitors in touch with reliahle established firms likely to be interested in taking up their agencies.

The British section is to be housed in the International Pavilion, near the Stadium and the French and Italian buildings—one of the finest and most accessible sites in the Exhibition grounds.

ON THE DISTRIBUTION OF QUININE IN THE BLOOD.

By O. S. Gibbs, M.B., Ch.B.

Pharmacology Dept., Dalhousie University, Halifax, Nova Scotia.

Before the Nova Scotian Institute of Science.

Quinine is a substance having the remarkable powers of forming films of high concentration at an interface. As was pointed out by Ramsden it may actually produce solid films.

If quinine be filtered some always becomes absorbed on the filter, and if a celloidin thimble is used to filter a dilute solution, no quinine may appear in the filtrate. Furthermore, the concentration inside the thimble falls.

These facts led me to examine the distribution of quinine in the blood; since if quinine were absorbed on the erythrocytes, thus forming a film, though perhaps very thin, of high concentration, it would offer further explanation of its value in the treatment of malaria.

The method of analysis used was described by Ramsden and Lipkin which utilises the relative insolubility of quinine in a saturated solution of ammonium sulphate to form clouds with Tanret's reagent. The same solution being used to obtain protein free extracts from the blood. Like King and Acton I was unable to confirm the accuracy of this method, which has very many fallacies, and even using a better extraction method was only able to obtain between 70-80 per cent. yield of the quinine.

The results of these experiments show clearly that quinine is very difficult to extract completely from the blood debris, and as is to be expected the greater the amount of debris, the greater the loss. In my experiments in which 10 cc. of blood, to which quinine was added, was centrifuged into two layers, the upper one being clear serum, I found like King and Acton more or less equal amounts were extracted from the serum, and the blood cells. It should be noted however that the cell debris is much larger than that of the serum.

When the blood is hæmolysed, and then centrifuged, the two layers (upper 5 cc. and lower 5 cc.) appear identical, although the lower one contains the " ghost " of the cells. They also give an approximate amount of debris. Under these conditions, however, more quinine is always found in the lower layer, varying from 6-40 per cent. more.

This fact appears most easily explained by assuming the adsorption of quinine into the " ghosts," and if this be true on to the intact cells. In any case the diffusion of quinine into the cell, evel if it occurs, would probably be a very slow process; whereas, as Rona and Block point out, the distribution of quinine takes place with " unmeasurable rapidity."

Summary.

1. King and Acton's results on the use of Ramsden and Lipkin's method are completely confirmed.

2. Using a modified technique very similar to these authors between only 70-80 per cent. of the added quinine has been recovered.

3. Under the conditions of the experiment the yield from the serum approximately equals that from the blood cells.

4. Quinine is probably adsorbed into the blood cells.

SCIENCE OF KEEPING FIT.

Food Values.

Certain people, says the *Times Trade Supplement*, especially people who are no longer young, experience great difficulty in digesting fats.

They are apt, even after partaking of so " mild " a fat as ordinary cream, to experience pain and discomfort. On the other hand, so long as fatty foods are avoided all is well.

These people curiously enough, seem to enjoy better health during the winter months than during the summer. Most of them, when the daylight becomes strong in April, pass through a time of some weakness.

There was no explanation of this curious state of matters until the discovery was made that sunlight exercises on the body an effect very similar to that exercised by animal fats. We are now, however, in a position to say that those who find fats difficult to digest are likely to fare better in dark weather than sunny. They are apparently over-sensitive to what is called the " A " vitamin. This over-sensitiveness may, as experience has shown, be overcome to some extent by making cereals of one kind or another the basis of diet—for all the cereals contain a quality, or vitamin, which is opposed in its action to the " A " vitamin and to sunlight. A plate of porridge, for example, taken daily, may exert a highly beneficial effect on the digestions of persons who cannot eat fat. It may even enable these persons to eat fat without discomfort. And it may fortify them to some extent against the ill effects of strong sunlight.

On the other hand, people who are too little sensitive to the " A " vitamin fare badly when they take porridge, and often seem to suffer from boils and other skin troubles if this cereal is eaten regularly.

These observations—they are isolated as yet—lend new weight to the old proverb that " what is one man's meat is another man's poison." It would seem that each one of us has his or her special sensibilities. Some of us are too sensitive in one direction; others, in that same direction, are not sensitive enough.

Food Values.

Food therefore possesses different values in nourishment for different people. A very little fat is more than enough for one man in the darkest weather; another man must have a great quantity of fat even at mid-

summer—as in the immortal instance of Jack Spratt and his wife.

It is not possible to say that any of these variations are "abnormal." All that can be said with assurance is that every man must, in the matter of diet, become his own physician. He must study his own reactions to food, and so gradually learn which foods agree with him and which foods disagree.

It is the greatest folly in the world to eat foods which have been found to be unsuitable—the result is always the same.

The truth is that our present knowledge about nutrition and diet is deficient in almost every direction. We are only now beginning to obtain a gleam of enlightenment. That gleam is revealing the fact that food acts on the human body in a way which is not really accounted for by present conceptions. We have still, in short, to learn some very elementary lessons about food.

One of these lessons, perhaps the most important, concerns not the food itself but the body into which the food goes. What is it which renders certain people incapable of enjoying or even of digesting certain articles of diet? Why can Jack Spratt eat no fat?

These questions may seem frivolous enough to the uninitiated. In fact, they are fundamental. For did we but know the answers to them we might be able to suggest diets which would have the effect of changing the picture of ill-health into that of fitness.

Meanwhile, as has been said, each of us had better learn to know his own constitution. Those who study their food, in the experience of the writer, live long and avoid disease.

DETECTION OF CARBON MONOXIDE IN MINES.

(Abstracted from *Chemical Engineering*, South Africa.)

Directions for the use of the iodine pentoxide detector in determining the amount of carbon monoxide in mine air have been prepared by the United States Bureau of Mines in order that mine rescue workers may familiarise themselves with the use of this device, which ascertains the amount of this dangerous gas in mine air quickly, simply, and with reasonable accuracy.

Carbon monoxide is often found in mines, particularly during and after mine fires and explosions, state G. S. McCaa and John A. Davis, in information circular No. 6057, recently published by the bureau. This gas has the property of combining with the hæmoglobin or red colouring matter in the blood and thus preventing the normal delivery of necessary oxygen to the various tissues of the body. Because of this headaches and discomfort frequently result after two or three hours of breathing an atmosphere containing as little as 0.04 per cent. of carbon monoxide, while exposure to a concentration of 0.3 per cent. usually produces unconsciousness in 20 or 30 minutes—followed by death if the victim is not promptly removed to fresh air. The gas is all the more dangerous because it is colourless, odourless, and tasteless, thus affording no warning of its presence that can be perceived by the unaided human senses.

The various methods commonly used by the Bureau of Mines for determining the presence of carbon monoxide in mine air include: observation of the effect on small animals, particularly vanaries and mice; the pyrotannic acid method of determining carbon monoxide in blood samples; volumetric gas analysis by absorption or combustion; and the iodine pentoxide method. The underground use of the pyrotannic acid method is somewhat restricted by its limitation to ais containing not over 0.2 per cent. of carbon monoxide. Volumetric gas-analysis methods require technical skill and training on the part of the analyst, as well as apparatus that is either too delicate or too cumbersome to be carried about underground, hence these methods are employed almost exclusively in the laboratory. The iodine pentoxide hoolamite method, however, permits the use of a carbon monoxide detector which readily and simply determines the amount of carbon monoxide in mine air. As the method is of comparatively recent origin, it is not known as well as might be advantageous to men concerned with fighting mine fires or with rescue and recovery after mine explosions.

The most essential feature of the detector is a small glass tube containing granular pumice stone impregnated with a mixture of iodine pentoxide and fuming sulphuric acid. This mixture is called hoolamite, after Hoover and Lamb, who patented the formula. When air containing carbon monoxide is forced through the tube by means of a rubber aspirator bulb and suitable valves, iodine is liberated and the original white of the granules is changed to various shades of bluish green or even violet-brown

or black, depending upon the amount of carbon monoxide.

One should recognise that the detector does not indicate a deficiency of oxygen in the atmosphere or the presence of such other gases as carbon dioxide and hydrogen sulphide; nor does it automatically give warning of carbon monoxide as the operator may be in an atmosphere containing this gas without using the instrument. Hence, in these respect, the detector is inferior to canaries or mice. However, when in good condition and properly used, the detector affords a reasonably accurate quantitative means of determining, while underground, the percentage of carbon monoxide in the air, which it is impossible to do with small animals. Also, birds or mice should be returned to fresh air to revive them after being overcome by carbon monoxide, whereas use of the detector permits a rescue crew to proceed without delay, and additional tests for carbon monoxide can be made as the work progresses. Furthermore, the instrument is light, compact, and easily carried in the mine, needs little attention, and requires no special ability or skill for operation other than that of distinguishing between different shades of colour. All of these advantages make the detector an extremely valuable tool for use by men in mine-rescue and recovery work or by any others who must breathe air in which carbon monoxide may be found.

GENERAL NOTES.

SOIL SURVEYS IN CANADA.

In view of the widespread interest that is being taken in the procuring of settlers for the farm lands of Canada and in the establishing of agriculture on a more scientific basis, Mr. W. A. Johnston of the Geological Survey, Department of Mines, Ottawa, presents some interesting facts about soil surveys. He states that soil surveys have been carried on to some extent during the past few years by the Provincial Governments in the prairie provinces, that land classification work has been done by the Department of the Interior, and that the mapping of soils, which is primarily a geological problem, has been conducted by the Geological Survey.

A soil survey of any area shows the character and location of the several types of soil in the area and thus provides information regarding soil conditions that is of value not only to the farmer but to the scientific agriculturist outside the area who is called upon to give advice regarding questions of soil improvement or who is attempting to solve problems regarding the most effective uses of certain kinds of soil. The fundamental principle of a soil survey is that each type of soil is best adapted to certain kinds of crops and requires the same kinds of farm practices and methods of soil improvement. It is held by scientific agriculturists that the art of agriculture, the oldest and most fundamental of the sciences, is the least developed and it is well recognised that there are at least a few distinct types of soil in each of the physiographic provinces that require different methods of cropping and farm practice. A soil survey in many cases reveals important problems of soil improvement and farm practice that need attention. The perennial question of how long exclusive grain growing can be carried on in the prairie provinces is partly a question of the character of the soil, for some soils can be cropped continuously much longer than others. Again, the question of soil drifting, which has become a serious problem in many parts of the prairie provinces, is partly a question of the character of the soil, for some soils drift badly, whereas others do not. A soil survey also affords a guide in the buying and selling of farm property and in the selection of land for particular purposes.

VISIT OF THE COMMERCIAL SECRETARY IN THE UNITED STATES OF AMERICA.

The Department of Overseas Trade announce that Mr. A. J. Pack, the Commercial Secretary in the United States of America, will shortly visit this country on official business.

Mr. Pack will be available at the offices of the Department for a few days commencing on March 18, for the purpose of interviewing representatives of United Kingdom firms interested in the export of British goods to the United States of America. He will subsequently visit a few of the principal commercial centres in the United Kingdom.

Application for interviews in London should be addressed to :—

The Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 12796/1.

BRITISH CHEMICALS.

The Association of British Chemical Manufacturers, 166, Piccadilly, W., has compiled an Official Directory giving a complete list of its members and a classified list of British made chemicals, together with notes on their applications. This Directory is published by Ernest Benn at 10s. 6d., under the title of *British Chemicals, Their Manufacturers and Uses* (330 pages).

For the convenience of overseas buyers, synonyms in six languages are given and it may be emphasised that the members whose products are listed are all *bona fide* British manufacturers.

The British Chemical Plant Manufacturers' Association, 166, Piccadilly, have also compiled a Directory (obtainable free on request), containing a classified list of products and services of *bona fide* makers. It places before users and industrialists the plant made in Great Britain.

Both these Directories should be consulted by firms and others requiring chemicals, chemical apparatus, etc.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

BOARD OF TRADE ANNOUNCEMENT.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during February, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 611, of which 588 were from merchants or importers. To these should be added 17 cases outstanding on the 31 January, making a total for the month of 628.

DYESTUFFS INDUSTRY DEVELOPMENT COMMITTEE.

The Board of Trade have appointed Mr. Forrest Hewit, of the Calico Printers Association, Limited, to be a member of the Dyestuffs Industry Development Committee, in place of Mr. W. H. Dixon, resigned.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, March 7.

The Stability of Complex Metallic Salts. By F. G. MANN.

The stability of complex metallic salts is usually considered to be dependent on the electronic structure of the co-ordinated metal, since the latter has endeavoured, by the process of co-ordination, to increase the number of its electrons to that of the next inert gas. Instability may be caused by the co-ordinated metal possessing a deficiency or an excess of electrons, although a deficiency is usually more readily tolerated than an excess. A second factor is now considered, *viz.*, the comparative ease with which, *e.g.*, a polyamine molecule can, by virtue of its own molecular structure, arrange itself around a complex that may be a square, a tetrahedron, or an octahedron. $\alpha\beta\gamma$-Triaminopropane co-ordinates very firmly around the 6-co-ordination octahedron, and in consequence bivalent nickel, zinc, platinum and palladium all give salts containing the bis-triaminopropane-metallic complex, $[\{NH_2.CH_2.CH(NH_2).CH_2.NH_2\}_2M]''$. From the electronic point of view these salts should be very unstable, since the metal, of co-ordination number 6, has in each case an excess of 2 or 4 electrons. Actually, they possess very great stability. Each of these bivalent metals has adopted the unusual (and in the case of platinum and palladium, quite abnormal) co-ordination number of 6 in order to provide the octahedron necessary for maximum stability of the completed complex salt. This factor has thus outweighed in effect that dependent solely on the electronic state of the co-ordinated metal.

The Determination of Unsaturated and Aromatic Hydrocarbons in Light Oils and Motor Spirits. By A. B. MANNING.

0.2-0.5 g. of the oil is vaporised in a current of air and passed through a "potash bulb" charged with a mixture of concentrated nitric acid (10 per cent.) in concentrated sulphuric acid. The increase in weight of the bulb gives the total unsaturated and aromatic hydrocarbons in the oil. The acid solution is then heated at 100° for 2-3 hours to complete the nitration of the aromatic hydrocarbons, and the oxidation

of the unsaturated hydrocarbons. The cooled solution is poured into water and extracted with benzene. The benzene extract is itself extracted with 10 per cent. sodium hydroxide and is finally evaporated to dryness. The aromatic hydrocarbons in the original oil are calculated from the weight of the nitro-compounds so isolated.

Studies of Electrolytic Polarisation. Complex Cyanides. By S. GLASSTONE. (a) *Silver.*

The cathodic potentials of silver and the current efficiencies for metal deposition have been investigated in argenticyanide solutions. The results suggest considerable polarisation in solutions in which it would not be expected, and almost none in solutions containing an excess of free cyanide. By determining the variation of the static potential of silver in argenticyanide solutions with changes in the Ag/CN ratio, the differences in behaviour of the various solutions have been explained. It is shown that the cathode potential of a polarised silver electrode in a cyanide solution must rise rapidly from 0.0 to −0.4 volt, and then much more slowly to about −0.55 volt; after this point there should be another rapid rise in potential to −.85 volt, when hydrogen evolution commences. The shapes of the cathode potential-*C.D.* curves do not throw any light on the rate of dissociation of the argenticyanide ion, as Foerster (*Z. Elektrochem.*, 1907, XIII, 561) imagined. If the limiting *C.D.* at which the current efficiency for metal deposition is 100 per cent. is assumed to be the point at which the argenticyanide ion diffuses to the electrode at its maximum rate, then it is shown that this ion dissociates rapidly. The influence of rise of temperature and of stirring have been investigated; both these factors raise the limiting *C.D.* for 100 per cent. metal deposition.

(b) *Copper.*

The rate of dissociation of the cuprocyanide ion into simpler ions has been hitherto assumed to be very slow; it is shown that this conclusion is not necessarily correct. The cathode potentials of copper and the current efficiencies for metal deposition have been determined in a number of cuprocyanide solutions at various *C.D.* Considerable polarisation has been observed, especially in solutions containing an excess of free cyanide. The reasons for this behaviour are discussed, and it is shown that the results may be explained without assuming a slow dissociation of cuprocyanide ions; in fact, some experimental results are definitely opposed to this idea of slow dissociation. The potential of a polarised copper cathode in a cyanide solution must rise fairly rapidly from −0.25 to −0.9 volt (approx.), and at the latter potential hydrogen evolution can occur simultaneously with copper deposition; the current efficiencies must, therefore, fall below 100 per cent. Rise of temperature and stirring both decrease polarisation and increase the current efficiency very appreciably. The theories of copper deposition from cyanide solutions, like those for silver deposition, are unsatisfactory, and an alternative view is proposed.

Properties of Conjugated Compounds. Part VIII. The Additive Formation of cyclohexenes. By E. H. FARMER AND F. L. WARREN.

In the self-additive (dimerisation) and maleic anhydride reactions of conjugated hydrocarbons the addenda are of non-dividing type. The maleic anhydride addition of Diels and Alder (*Annalen*, 1928, CCCCLX, 98), affords a method of testing the tendency of butadienes (open-chain, extended, heterogeneous and cyclic) to add a non-dividing addendum at the 1 : 4-position, i.e., to yield substituted *cyclo*hexenes.

The two-stage nature of these additions is considered; especially, the formation of an ethylidene*cyclo*hexene from the hexatrienes, in contrast with the mode of bromine addition of the latter, indicates that selection of the position of the second point of attachment of the addendum (as between the even carbon atoms of the butadiene chain) is not solely controlled by polar factors.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

ANNUAL GENERAL MEETING, 1 MARCH, 1929.

At the Annual General Meeting of the Institute of Chemistry held at 30, Russell Square, Dr. Harold G. Colman presided in the absence of Professor Arthur Smithells, who is at present on a visit to South Africa.

The Report of Council and the Annual Accounts were received and adopted. The roll of membership of the Institute at the end of January consisted of 1,855 Fellows and 3,708 Associates, in addition to nearly 700 registered Students; the assets of the Institute were valued at over £18,500, not including special funds and the value of its premises and contents. The Report showed

that the Council had been active during the year in the interests of the profession and that many interesting papers had been read and discussions held by the Local Sections both at home and in the overseas dominions.

The Meldola Medal for 1928 was awarded to Dr. John Alfred Valentine Butler; and the Pedler Scholar for the year is Mr. George Morrison Moir.

The Chairman read an address from the President, in the course of which he commented on the progress of professional organisations such as the Institute, their importance to the professions concerned and their place in the affairs of the country. He said that the standards of attainment set by the Institute must, unfortunately, always cut off from professional recognition a considerable number of those who aspired to it. Such persons might think these standards too exacting, but that did not necessarily debar them from the calling of a chemist, and they might yet carry a marketable and a useful quota of chemical attainments; but speaking for himself, and not as President of the Institute, he considered that the notion of making chemistry a closed profession was entirely impracticable. He hoped that, so far as any proposal for registration was concerned means would be found for dealing with the special needs of the profession of chemistry, bearing in mind that the Institute had been definitely entrusted with the duty, and already afforded the means of maintaining a register of chemists on which the Government, industry and the public increasingly relied. He was anxious, in any event, to ensure that the Institute should not be suspected of any unsympathetic attiture towards those outside its ranks who could usefully pursue a chemical calling. He had known nothing in the Councils of the Institute to give the least ground for any such suspicion. Few people could have had a better opportunity than he had of seeing the mischief that could be wrought by the misuse of the title "chemist." He was not referring to the standing misfortune of being confused with members of the profession of pharmacy; but he was thinking especially of the view held by some industrialists who had got so far as to understand that there was another kind of chemist than the pharmacist, but had little conception as to what that kind of chemist should be. They knew that the chemist had some industrial value; they knew that he could analyse and could evaluate what they had to buy and sell; and they knew that his analytical craft could be acquired and bought on very reasonable terms; but from direct knowledge he could still say that some industries were being seriously handicapped by the name of chemist being taken in vain. He hoped, however, that those concerned with chemistry would preserve the excellence of the freedom, variety and flexibility that characterised our British ways. The Institute had every variety of chemist within its ranks and was truly representative of the profession. Its primary purpose was to be of public service, and the State looked very frequently to it for information and advice. It was becoming more and more recognised as the body which could speak authoritatively on all chemical matters within its province.

THE PHYSICAL SOCIETY.

Friday, March 8.

The Dependence of the Mobility of Ions in Air on the Relative Humidity. By EZER GRIFFITHS, D.Sc., F.R.S., AND J. H. AWBERY, B.A., B.Sc.

The relationship between relative humidity and the mobility of negative ions in air at atmospheric pressure has been examined with a view to possible applications in hygrometric measurements. The apparatus employed was a modification of Zeleny's original method; the end of a wind channel being closed by a disc of gauze fitted with a guard ring through which a steady stream of air of definite humidity was pumped.

The motion of the negative ions due to the action of the air stream was balanced by a counter potential gradient, and the mobility deduced from the critical potential required to produce a balance. The arte of air flow was measured by means of an Ewing Ball and Tube Flowmeter, using a hollow glass sphere to make it suitable for low air rates. Efforts were made to construct a direct indicating instrument by amplifiying the current sufficiently to obtain deflections on a robust moving-coil indicator, but the variations in the amplification factor were found to be too serious.

Some Unsolved Problems Relating to the Mobilities of Gaseous Ions. By PROF. A. M. TYNDALL, D.Sc.

The paper summarised the present position in the following aspects of the subject:

1. Factors which on theoretical grounds may be expected to be of predominant influence.

2. Effect of vapours.

3. Difference between mobilities of positive and negative ions.

4. Nature of the negative ion.

5. Nature of the positive ion and the effect of age.

6. Experiments in pure gases.

SOCIETY OF PUBLIC ANALYSTS.

Annual Meeting.

The Annual General Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, March 6, when the President, Mr. Edward Hinks, delivered his Annual Address.

The following were elected as Officers and Council for the year 1929:—

President—Edward Hinks. *Past Presidents serving on the Council* E. Richards Bolton, A. Chaston Chapman, Bernard Dyer, P. A. Ellis Richards, G. Rudd Thompson, E. W. Voelcker, J. Augustus Voelcker. *Vice-Presidents*—John Evans, J. T. Hewitt, T. Macara. *Hon. Treasurer*—E. B. Hughes. *Hon. Secretary*—F. W. F. Arnaud. *Members of Council* — A. P. Davison, E. V. Jones, R. Lessing, A. More, W. Partridge, C. A. Seyler, J. T. Dunn, N. Evers, G. Roche Lynch, C. J. H. Stock, J. R. Stubbs, Geo. Taylor.

An Ordinary Meeting of the Society then followed, the President, Mr. Edward Hincks, being in the chair.

Certificates were read for the first time in favour of Peter Trevisa Clarke, B.A., Alfred Clive James, B.Sc., A.I.C., Herman Lee, B.Sc., A.I.C., James Frederick Morse, Lawrence John Odling, Willie Horne Wilkinson.

Certificates were read for the second time in favour of Frank Atkins, Edmund Baron Bennion, M.Sc., A.I.C., John Haslam, M.Sc., A.I.C., Stanley Gordon Kendrick, B.Sc., A.I.C., Bryn Jones, B.Sc., A.I.C., John Upton Lewis, B.Sc., A.I.C., and Leslie John Walker.

The following were elected Members of the Society:— William Bennett Adam, M.A., A.I.C., Alfred Louis Bacharach, B.A., F.I.C., Andrew Dargie, B.Sc., A.I.C., and Wadie J. Itayim.

The following papers were read and discussed:—

The Alkaloid Test for Tannin. By Christine Mary Fear, B.Sc. (Work done under the Analytical Investigation Scheme.)

The Cryoscopic Method for the Detection of Added Water in Milk. By A. L. Andrew.

Investigations on the Relations between the Acidity and Freezing Point of Milk. By Alfred J. Parker and L. S. Spackman.

NOTICES OF BOOKS.

Die Rolle der zyklischen Aminosaureanhydride in der neueren Strukturchemie der Proteine. By Dr. E. Klarmann. Pp. 94. Berlin and Vienna: Urban and Schwarzenberg. 1929. Price 9 marks.

Dr. Klarmann is well known for his contributions to the elucidation of the structure of the proteins. He has continued the study of these complex organic bodies at the point where the late Prof. E. Fischer's researches left off. He has advanced a theory of cyclic (dioxypiperazine) structure for the more complicated animal protein derivatives and has been able to prepare a number of synthetic compounds in support of his views.

PUBLICATIONS RECEIVED.

U.S. Bureau of Standards.

A Technical Method for using the Mercury Arc to obtain Data at Wave Length 560 in the Spectrophotometric Analysis of Sugar Products. By H. H. Peters and F. P. Phelps. (Research Paper 38). Price 5 cents.

Reflecting Power of Beryllium, Chromium and Several other Metals. By W. W. Coblentz and R. Stair. (Research Paper 39). Price 5 cents.

Heats of Combustion of Organic Compounds. By M. S. Kharasch. (Research Paper 41.) Price 15 cents.

Laboratory Corrosion Tests of Mild Steel with Special Reference to Ship Plate. By H. S. Rawdon. (Research Paper 42.) Price 5 cents.

The Service of Refractory Blocks in a Small Experimental Glass Tank. By W. L. Pendergast and H. Insley. (Research Paper 44.) Price 15 cents.

Forthcoming Events.

ROYAL INSTITUTION.

Friday, March 15, at 9 p.m.—Prof. V. M. Goldschmidt : " The Distribution of the Chemical Elements."

Saturday, March 16, at 3 p.m.—Sir Ernest Rutherford : " Molecular Motions in Rarefied Gases."

Tuesday, March 19, at 5.15 p.m.—Dr. Stanley W. Kemp : " Antarctic Whaling Expeditions."

Thursday, March 21, at 5.15 p.m.—Rev. Wm. H. Draper : " The Change in Meaning from One Period to Another."

Friday, March 22, at 9 p.m.—Sir Ernest Rutherford : " Penetrating Radiations."

Saturday, March 23, at 3 p.m.—Sir Ernest Rutherford : " Molecular Motions in Rarefied Gases."

Monday, April 8, at 5 p.m.—General Meeting.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

A Meeting of the Society will be held in the Lecture Hall at the above address on Wednesday, 20 March, 1929, at 7.30 p.m.

A Discussion will be held on Dr. H. Moore's Paper on " The Mode of Formation of the Image in the Microscope," in which the following amongst others are expected to take part :— Captain M. A. Ainslie, Mr. C. Beck, O.B.E., F.R.M.S., Mr. J. W. Gordon, K.C., Sir Herbert Jackson, K.B.E , F.R.S., Professor A. W. Porter, F.R.S., and Mr. J. Rheinberg, F.R.M.S.

MINERALOGICAL SOCIETY.

Tuesday, March 19, at 5.30 p.m.—Mr. A. W. Groves and Mr. A. E. Neuman : " Inclusions in the Apatites of Some Igneous Rocks." Mr. L. A. Barayana Iyer : " Calc-Gneisses and Cordierite-Sillimanite-Gneisses of Coimbatore, Madras Pres., and of Similar Occurrences in India." Mr. F. A. Bannister : " A Relation Between the Density and Refractive Index of Silicate Glasses with Application to the Determination of Imitation Gem-Stones."

ROYAL SOCIETY OF ARTS.

Wednesday, March 20, at 8 p.m.—(Ordinary Meeting). Professor A. E. Richardson, F.R.I.B.A. : " Modern English Architecture."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

5,651.—Baum, G., and Deutsche Gold- und Silber Scheideanstalt - vorm Roessler.—Obtaining hydrogen peroxide by distillation. February 20th.

5,971.—Bunn, C. W.—Manufacture of ammonium chloride crystals. February 23rd.

5,876.—Guillissen, J.—Production of ammonium phosphates. February 22.

5,971.—Imperial Chemical Industries, Ltd.—Manufacture of ammonium chloride crystals. February 23rd.

5,906.—I. G. Farbenindustrie Akt.-Ges. —Production of mixtures of nitrogen and hydrogen. February 22nd.

Specifications Published.

306,052.—Johnson, J. Y.—Production of sulphonic acids.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

303,494.—Acetic acid. — Suida, H., 33, Jubilaumstrasse, Mödling, Austria.

Acetic acid is extracted from its aqueous solutions by a mixture of a base such as quinoline and its homologues, dimethyl aniline and the like which is not readily acetylated and a hydrocarbon such as anthracene oil, heavy oil, paraffin oil, spindle oil, hydrogenated naphthalene, solvent naphtha, gas oil, solar oil, heavy benzine, oil from the destructive hydrogenation of coal, and pentachlorethene. It is important

that all ingredients of the solvent should have boiling-points above 150° C., as otherwise the final separation of the acid from the extract would be difficult. Examples describe the use of equal parts of anthracene oil and quinoline and of 2 parts "dekalin" and 1 part dimethyl aniline.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ESPONAL.

493,601.—All goods in class 3 which includes chemical substances prepared for use in medicine and pharmacy.—Bush & Co., Ltd., Swan Street, Minories, London, E.1. February 27th.

VETSULES.

499,336.—Chemical substances used for agricultural, veterinary and sanitary purposes. — The British Drug Houses, Limited, 16 to 30, Graham Street, City Road, London, N.1. February 27th.

FORMOIDS.

492,912.—Chemical substances prepared for use in medicine and pharmacy.—Boots Pure Drug Company, Ltd., 37, Station Street, Nottingham. February 27th.

CAMFORTOL.

497,480.—Chemical substances prepared for use in medicine and pharmacy.—Frank Hugh Ledsham, 78, Hearnville Rd., Balham, London, S.W.12. February 27th.

"EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News*.
Price 5s.

PERIODICALS FOR SALE.

Advertiser has a stock of back numbers of Scientific Periodicals which he is willing to sell at one-third published price, or less. Typed list sent on receipt of 1½d. stamp.—Write, G. D., c/o *Chemical News* Offices.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

Sole Makers: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3597.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Magnetism 178
By F. H. Loring.
Deposition of Radium, etc., at Dropping Mercury Cathode 180
By J. Heyrovsky and S. Berezicky.
The Collinsics of Minerals. X. 184
By Hawksworth Collins, B.A.
Stop Watches for Science Work 186
General Notes 186
Proceedings & Notices of Societies:—
Institute of Metals 187
Society of Public Analysts 188
Correspondence 190
Forthcoming Events 191
New Patents 191
New Trade Marks 192

GAS CYLINDERS.

The Department of Scientific and Industrial Research have just issued, price 4d., a summary of the Committee's recommendations concerning ordinary commercial cylinders for containing the "permanent" gases.

The following figures are significant as definitely establishing the bacteriological efficacy of Lysolats.

Professor Huynen of the State Veterinary University of Brussels recently discovered that a 1% solution of Lysolats (solid form of lysol) in water arrested the developments of bacterial growth in two seconds.

A 1% solution of Lysolats was tried on the following organisms:—

B. Coli was killed in 40 seconds.
B. Bang ,, ,, ,, ,, ,,
B. Pneumococci ,, ,, ,, ,,
B. Typhosus ,, ,, ,, ,,
B. Staphylococci ,, ,, 50 ,,
B. Pyocyaneus ,, ,, ,, ,,

These facts should be of special interest to House Surgeons and Physicians, Hospital Dispensers, Medical Officers of Health, etc. While the cresylic acid content of saponified tarry preparations is of some importance, it will be agreed that germicidal efficiency is the vital factor in the choice of an antiseptic and disinfectant. Lysolats are an antiseptic and disinfectant fulfilling the recognised standards, but with a greater germicidal power than any other known to science.

Members of the Medical Profession are invited to write for free samples of Lysolats to Solidol Chemical Ltd., Ashmead House, Disney Street, London, S.E.1.

Lysolats

PATENT 11667 **(LYSOL TABLETS)**

Lysolats are packed in handy tins containing 40 and 80 tablets at 1/3 and 2/- (respectively) and also in tins of 1,000 tablets.

O

MAGNETISM.

By F. H. Loring.

(*Concluded.*)

So far I have dealt only with one atomic or molecular phase of magnetism, but it is known that when a conductor is carrying a current, as if it were a pipe conveying electrons, there is a magnetic field exterior to it.

It may be supposed that this field is due to each electron vortex contributing its quota of magnetism, and to carry this idea into effect it would seem necessary to have the electrons *paired*, so that their magnetic lines of force (taking the pair) form a sort of fan which fades out in its intensity as the distance from the conductor increases. This would involve several conditions. In the first place, the pairs would have to be arranged as if polarised in planes at right angles to the axis of the conductor and then to make up concentric rings with little spaces between them, while the axis of each vortex extended outwards from the regions of the conductor like spokes radiating from a wheel's hub. Now if a sketch be made along these lines it will be seen that, while the electrons march slowly in pairs, their magnetic lines will coincide with imaginary concentric circles round the conductor, such circles representing in effect the resultant of the many individual 'elements.' The idea of making up the encircling lines round a current-bearing conductor of magnetic elements, having their small ends in the atoms of the conductor, is an old idea of mine which I illustrated in these pages some years ago (see *Chemical News*, 1917, 115, 181). These so-called elements involving magnetism in the sense of magnetic lines would seem to fit in well with the electron vortex idea I have recently given (*Chemical News*, 1929, 138, 116) and which I have carried along as a necessary feature in the magnetic phenomena already discussed.

The question now to be raised is, Can anything be found in the whole vast scheme of natural phenomena which will suggest the idea of vortices? The tornado is one, and the structure of sun-spots is perhaps another. Moreover, the sun-spots give evidence of strong magnetic phenomena in which pairings as I have just described are prominent according to the extensive investigations and views of G. E. Hale. The following from Russell, Dugan and Stewart's Astronomy, 1927, vol. 2, p. 526, gives the supporting evidence here mentioned :—

"According to this theory, a sun-spot is a great funnel-shaped vortex in the outer layers of the sun, within which the gases are ascending spirally upward and outward (with a motion exactly opposite to that of water running out of a wash-basin).

"The rapid expansion at the throat of the funnel cools the ascending gases and may maintain for weeks a temperature fully 2,000° Centigrade below that of the surrounding photosphere. Thus a sun-spot is the greatest refrigerating mechanism known to exist.

"This cooling accounts for the darkness of the spot . . . for the existence in it of compounds giving band spectra, and for the changes in the intensity of the [spectroscopic] lines. . .

"The origin of the magnetic field is doubtless associated with the rapid rotation in the deep-lying vortex, opposite polarities presumably corresponding to right-hand and left-hand whirls; but the exact nature of the electromagnetic action involved is still uncertain. It may well be related to the fact that the ascending gases carry great numbers of electrically charged particles.

"The components of a bi-polar group must be in some way connected, since the polarity is nearly always opposite in the two cases [thus showing the pairing above mentioned]."

The evidence here cited is, of course, a very large-scale phenomenon and it requires some stretch of the imagination to reduce it to an electron vortex in general principle; but be this as it may, the behaviour of sun-spots is suggestive of the action under discussion.

Now the reason why the electron vortices are confined to the conductor would seem to be the same reason that one vortex becomes attached to the positive electron or proton in the manner already indicated (see previous citation). In other words, the vorticellular *apex*, whether it exists apart from the positive counterpart of the electron or not, certainly would be expected to become anchored either firmly or in a movable way to the positive part of matter, according to circumstance.

Accepting this vortex theory as applied to magnetism, that is to say, indicating the nature of its origin, another question arises. Are the individual magnetic fields set up, the only fields, or do they create a greater field that is in reality their resultant, yet, in a sense independent and self-closed as regards the magnetic lines of force? Such an idea is almost equivalent to two æthers: a larger and a smaller!

If the views here advanced are near to the truth, then it should be possible to go a step further and give a sort of picture of the generation of a current by moving a conductor through a magnetic field. An attempt will be made.

It will be assumed that in a conductor the free electrons tend to associate in pairs like the sun-spot vortices forming U or V shaped structures, which are bi-polar, as above indicated, and that they will be oriented in all positions relative to one another. The impressed field would bring them more or less into line so that they would tend to fasten themselves to the lines of the field as flags (the U becoming a P), but pointing in various directions.

When the conductor is moved through this magnetic field the flags would all swing one way as in a wind, but the swinging pivots would be the *atoms*, and in so doing the vortices would all be such as to roll along in one direction, assuming a reacting surface intervening at the paired apexes, as the positive part of matter might afford this condition; but, I do not believe this to be the *impelling mechanism*—see below.

Considering now the action of a current-bearing conductor in a magnetic field, the circular orientation, so to speak, of the vortex pairs in the conductor causes a distortion of the impressed field and this produces an urging action on the conductor by reaction against the non-coincident magnetic elements of the vortex pairs maintained by the current.

Perhaps it would be better to consider the opposite action, discussed above, as due to a precisely similar effect as just stated, only acting *in a reverse manner* The impressed field and movement imparted to the conductor would cause the vortex pairs to move along in the conductor in seeking but not realising the ideal state of equilibrium.

It is assumed that where the apexes of the two vortices meet, forming a U or V, the line or lines of force through, or at, the intersection on positive matter would form the hinge, while the flux joining the open ends of the bi-polar vortices would, whenever possible, coincide with the impressed line or lines, but the latter would not form the *swinging pivots of the* vortex *pairs acting* as flags.

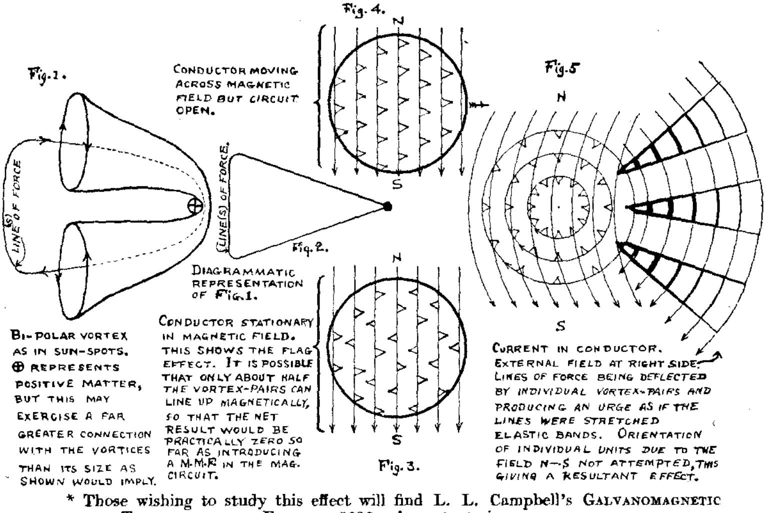
It must be remembered that the vortices of a pair are rotating in opposite directions, otherwise the flux could not join them up in the sun-spot way as above indicated.

The atoms are not continuous so that there would be gap-jumps if the vortex pairs are regarded as rolling along the positive parts of matter, but this is too mechanical a picture and leads to difficulties. The interaction of the magnetic fields is perhaps sufficient and indeed better.

It will be seen that the lines of magnetism *in passing* through or near to the positive matter at the apexes become shielded from joint action with the lines of the impressed field. This is somewhat different from anything that can be experimentally demonstrated, whereas practically all the other features could be demonstrated by a suitably-constructed model.

I believe that the words *neutralising* and *counteracting*, as used above, should be taken to include a local closed magnetic circuit; and, that *resultant* may mean something not yet fully understood, but it would include an *additive* effect.

These sketches, with accompanying remarks, show the essence of the newer ideas described above. In considering Figs. 3 and 4, it is perhaps better to regard the alignments as resolvable into four crossed arrows : one, N-S; one, S-N; one, E-W; one, W-E, using here the four points of compass to illustrate the direction-resolutions, so that only half the number of vortex-pairs in one belt taken across the conductor are alignable as indicated above. The fan-shaped representation of the lines, as on the right-hand side of Fig 5, are not the full number, obviously, since others would have their origins within the conductor. The rolling action, though almost dismissed from consideration in the text, has an attractive feature worth study in my opinion, especially in connection with the Hall effect.* *The large-diameter conductors, shown by Figs. 3, 4 and 5, are in cross-section, the cross-hatching being omitted owing to the insertion of the vortex-pairs,*



* Those wishing to study this effect will find L. L. Campbell's Galvanomagnetic and Thermomagnetic Effects, 1923, of great service.

THE DEPOSITION OF RADIUM AND OTHER ALKALINE EARTH METALS AT THE DROPPING MERCURY CATHODE.*

By J. Heyrovsky and S. Berezicky.

The Method.

The "polarographic" method here applied has been recently described in numerous communications (*e.g.*, *Rec. Trav. Chim.*, *l. c.*, p. 488, *Bull. Soc. chim.*, 1927, XLI, 1224). It consists in registering current-voltage curves contained on electrolysis of solutions when using as cathode mercury dropping slowly from a thick-walled capillary drawn to a narrow tip and as anode a large mercury layer at the bottom of the electrolyte vessel.

Conclusions are drawn from the increase of current, which, according to Faraday's law, must be due to reduction occurring at the cathode, whilst at the anode mercury passes into solution where it is usually precipitated by the anions as chloride, sulphate or hydroxide. The potential of the large mercury anode is thus kept constant during electrolysis so that the total polarising E.M.F. changes only the kathodic potential of the mercury dropping from the capillary.

It is well-known that the deposition of each metal becomes noticeable on current-voltage curves after reaching a certain value of the cathodic potential denoted as "deposition potential" of the respective metal.

If the galvanometer sensitivity is much decreased or a very small concentration of reducible matter is present in solution, a current is reached when the depositing ions, diffusing to the cathode, furnish a certain maximal "diffusion" current in the form of a "wave" at the current voltage curve; the magnitude of this diffusion current is proportional to the concentration of reducible matter in solution.

Both of these procedures of measurements, *viz.*, the evaluation of the "deposition potentials" and "diffusion currents"

* Abstract of a paper presented to the Česká Akademie Věd a Umení (Czech Academy of Arts and Science) December 19, 1928, and published in *Collection of Czechoslovak Chemical Communications, January*, 1929.

are fundamental in analysis with the dropping mercury cathode and will be here discussed in special cases.

A new, small-type " polarograph " used throughout in these investigations, was constructed by Dr. V. Nejedly[1].

EXPERIMENTAL.

RADIUM AND BARIUM.

Barium deposition potentials.—To be able to distinguish the " deposition potential " of radium from that of barium, first a series of curves was obtained with various solutions of pure barium chloride and hydroxide.

The mean figures from these measurements are :

In normal	$BaCl_2$	-1.761 ± 0.004 volt
Decinormal	,,	-1.793 ± 0.003 ,,
Centinormal	,,	-1.822 ± 0.003 ,,
Millinormal	,,	-1.844 ± 0.005 ,,

The measurements were carried out at room temperature (16°-18° C). The rate of dropping was, as usual, 3 seconds for each drop when unpolarised.

Radium deposition potentials.—First a series of curves was obtained with solutions of a mixture of radium and barium chloride *poor in radium. This specimen, denoted as* No. 66, was kindly lent by the Board of Education of the Czechoslovak Republic. Sealed in pre-war time, it contained 14.66 per cent. radium according to the estimation of the State Radiologic Institute. The contents were of greyish-brown colour, obviously affected by radiation. 79 milligrams of it were brought into 5 ccs of water, but did not dissolve to a clear solution; when introduced into water evolution of bubbles with a hissing noise was perceptible. On polarographic investigation the solutions gave curves much resembling those of barium of equal concentration, only the maximum was slightly more prominent and the deposition potential shifted somewhat to more positive values.

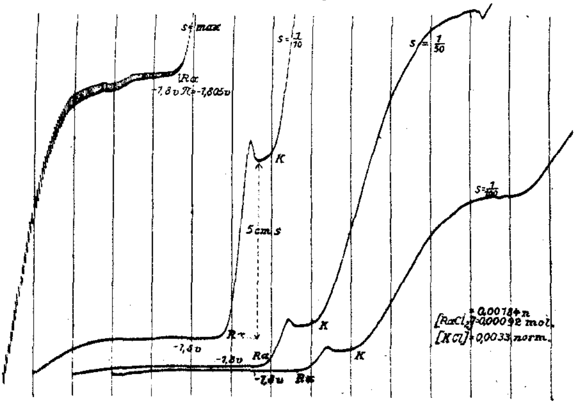
Thus, to obtain more accurate data, another specimen of radium chloride freshly prepared was provided for by the State Radiologic Institute of Czechoslovakia. According to the certificate this specimen, No. 194, contained 0.936 milligram metallic radium and consisted by weight of 97.3 per cent. radium chloride with 2.7 per cent. barium chloride; it contained thus, 1 atom of barium for 25 atoms of radium.

This new preparation dissolved clearly in the 3.00 ccs. of water placed in a small electrolysing vessel, giving thus a solution of $RaCl_2$ 0.00138 molar (with 4 per cent. of Ba).

Since none of the more concentrated radium solutions could be got rid of oxygen, its presence must be explained by the decomposition of water caused by the intensive radiation.

The " normal deposition potential " of radium was calculated as -1.718 ± 0.008 volt, *i.e.*, a value by about 43 millivolts more positive than the "normal deposition potential " of barium.

[1] Prague, Radešovice No. 92.



To another set of solutions a concentrated solution of potassium chloride has been added, in order to determine the magnitude of the " diffusion " currents, which could indicate the content of radium in solution. Fig. 1 is an example of this. The diffusion current due to a 0.00184 *n* concentration is 5 cms. high when $^1/_{10}$ sensitivity is applied; *i.e.*, it would cause a 50 cms. deflection, if the maximal sensitivity were used. Hence, in the presence of other electrolytes, to 10^{-4} gram-equivalent per litre, a " wave " 2.7 cms. high has to be ascribed. Similarly other curves show " waves " corresponding to 2.6-2.8 cms. per 10^{-4} *gr. eq. Ra* in solution. Thus, against the number 4.5 cms. for 10^{-4} *gr. eq. Ba*, the diffusion of radium ions appears to be almost twice slower.

From this polarogram (Fig. 1) also the difference in the deposition potentials of radium and potassium is noticeable, which allows to estimate the contents of both kinds of ions quantitatively, when remembering that the diffusion " waves " of potassium are almost four times as large as those of the equivalent concentration of radium (as 2.8 : 10). Another point of interest in Fig. 1 are the maxima, which become still more prominent when some more potassium chloride is added.

In order to see how far barium may be polarographically distinguished from radium, more barium chloride was added, so that the solution now contained radium to barium in the ratio 5 : 1. The polarogram Fig. 2, of this solution, 0.0006 molar in radium and containing 0.008 normal potassium chloride, shows distinctly the small " wave " due to the deposition of barium upon the larger one due to radium. The height of the waves is approximately 20 : 7 mm. which, taking into consideration the rate of diffusion of both radium and barium ions, agrees with the ratio as prepared in this solution.

When barium exceeds the concentration of radium, the first wave becomes indistinct; it becomes almost indistinguishable from the barium " waves " when the solution contains radium to barium in the ratio 1 : 10. However, even solutions containing still more barium could be analysed polarographically, if few drops of them were added to 2 or 3 ccs. of a pure solution of a radium salt; then again an excess of radium over barium ions would be reached and the ratio were determinable from the height of the two waves. This procedure need not be very costly, since 2 ccs. of a 2.10^{-4} molar solution would suffice, which contain radium for 2-3 dollars, and moreover, practically nothing of the solution is lost.

From the position of the two waves the deposition potential shift of the corresponding metals appears to be about 60 millivolts. Direct determinations mentioned above, give 43 millivolts as the difference between the deposition potentials from two equimolecular ionic concentrations of radium and barium.

From the slightly more positive value of radium in the deposition potential at the mercury cathode its position in the series of the electrolytic potentials cannot be, however, derived. It has been already pointed out in the first communication (*Phil. Mag.*, *l. c.*, 315) that the electro-deposition at a mercury cathode is facilitated by the affinity

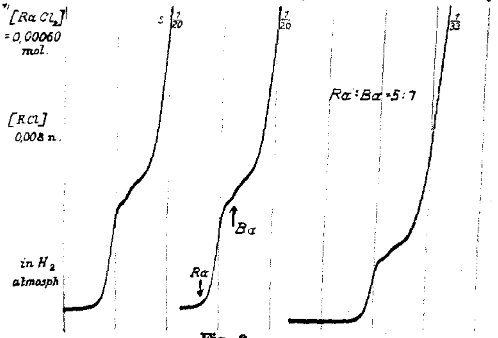


Fig. 2.

of the metal for mercury. Heavy metals, in general, show great affinity for mercury, *i.e.*, tendency to amalgamation. Thus even if the " electrolytic potential " of metallic radium were more negative than that of barium, the greater affinity of radium for mercury would cause its " deposition potential " to be more positive than that of barium. However, the " electrolytic potential " of neither of the two metals has been hitherto determined.

In conclusion to the radium-barium research it may be pointed out, that the " deposition potentials " of this pair of analogous elements stand well separated from the rest of the metals of alkalies and alkaline earths. Thus a polarographic wave occuring at 1.80-1.85 volt in neutral or alkaline solutions might be at the first glance with certainty ascribed to barium, if radium is not suspected. Also from the nobler metals all have their " deposition potentials " placed at considerable more positive potentials, the next being manganese with $\pi N = -1.34$ volt. Acidic solutions containing aluminium cover this range with " waves " due to the deposition of hydrions and aluminium ions; however the effect of these is easily removed by neutralisation with alkali hydroxides.

STRONTIUM AND CALCIUM.

The deposition potentials.—" The normal deposition potential," πN, of strontium cannot be observed directly with the maximal sensitivity owing to a certain amount of barium always present even in purest specimens of strontium compounds. Thus the increase of current, observable on the curve of a $m/10$ solution of strontium chloride or in the saturated solution o fstrontium oxide, which occurs at -1.86 volt (see Fig. 3), is due to the deposition of barium, which is well observable from the " wave " when a decreased sensitivity of the galvanometer is applied.

The height of " waves " shows that the solution of strontium chloride contains 3.6 per cent., and that of strontium oxide 2.2 per cent. of barium ions.

The figures due to the true deposition of strontium are considerably more negative, *viz.* :—

In a decinormal solution		-1.992 ± 0.002 volt
,, ,, centinormal	,,	-2.03
,, ,, millinormal	,,	-2.06

from which the " normal deposition potential " of strontium is calculated as -1.964 volt.

The solutions investigated for the deposition potential of calcium were prepared from pure Kahlbaum's calcium chloride and oxide. The turning points of 45° slope on the polarographic curves were:

In a normal solution		-2.047 ± 0.010 volt
,, ,, decinormal	,,	-2.069 ± 0.002 ,,
,, ,, centinormal	,,	-2.106 ± 0.003 ,,
,, ,, millinormal	,,	-2.134 ± 0.004 ,,

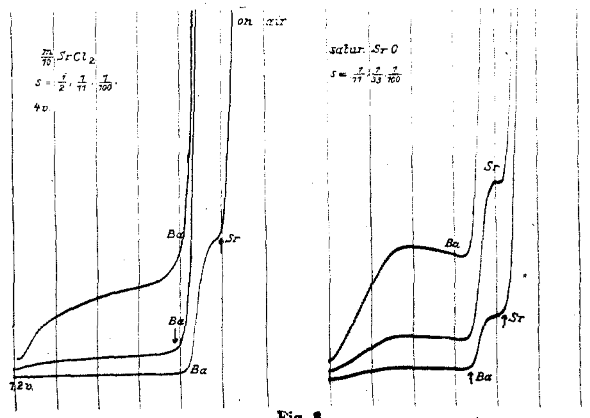


Fig. 3.

The normal deposition potential of calcium is, therefore, the most negative of all electro-reductions hitherto studied at the dropping mercury cathode.

MAGNESIUM AND BERYLLIUM.

The entire absence of any diffusion currents on the polarographic curves is shown in electrolysis of salt-solutions of magnesium and beryllium.

Magnesium. — The "deposition potential" of this metal is well observable, standing always halfway between that of calcium and strontium from solutions of an equivalent ionic concentration. The determinations give the mean value for the "normal deposition potential" of magnesium $\pi N = -1.996$ volt.

When increasing the polarising E.M.F. further over the deposition value, the current *increases without limits to intensities*, which cannot be explained by the deposition of magnesium ions, but must be due, again, as in the case of calcium, to a simultaneous evolution of hydrogen.

The increase after the "diffusion" current due to alkalies and alkaline earths, well marked on many polarograms requires attention. It has been observed already by the first workers with this method, Dr. Bloch, Dr. Gawalowski, Dr. Herasymenko, besides the present authors and must be regarded as due to a special sort of deposition of hydrions, since it continues to increase *beyond limits with the increasing polarising* E.M.F. However, the deposition of hydrions in acidic solutions starts already at -1.1 volt (comp. P. Herasymenko *Rec. Trav. Chim.*, 1925, XLIV, 503) being catalysed by the presence of hydrions in solution (comp. J. Heyrovsky: *ibid*, 499 and 1927, XLVI, 582).

Thus the second point of hydrogen deposition, occurring at about -3.0 volts, must be due to a new deposit formation, probably to the formation of a hydrogen amalgam, analogous to the ammonium or alkali-metal amalgams ("hydroxonium H_3O amalgam," comp. J. Heyrovsky: *Trans. Faraday Soc.*, 1924, XIX, 819).

The catalytic effect of magnesium ions, or of calcium ions when present in larger quantities, can then be explained by a hydride formation, which acts as a depolariser at the cathode and finally decomposes itself by water into hydrogen and the metallic hydroxide (comp. J. Heyrovsky: *ibid.*, 1924, XIX, 788).

Beryllium electro-deposition at the dropping mercury cathode offers difficulties; all its salts being hydrolysed, the solutions of beryllium deposit hydrogen at the potentials between -1.1 and 1.4 volt and even if the current voltage curves be taken with small sensitivities, no distinct waves due to the "diffusion" current of beryllium ions are observable. Moreover, all beryllium compounds contain aluminium as impurity, which metal deposits at -1.6 till -1.7 volt masking the possible deposition of beryllium ions. It is evident that beryllium when depositing at the mercury cathode causes a similar disturbing effect in the decomposition o fthe aqueous solution.

(To be concluded.)

THE COLLINSICS OF MINERALS. X.

By HAWKSWORTH COLLINS, B.A. (Camb.).

Phosphorus occurs in eleven of the following collinsics, and in the last paper it appeared in ten. Its relative volume is 14.56 and optical refractivity 10.51.

The first line of a collinsic gives the chemical formula of the mineral. The second gives the theoretical specific gravity, and the experimental S.G. The third line gives (between the brackets) the relative volume of each atom; and also the product obtained by multiplying the sum of these volumes by $\mu - 1$, where μ is the refractive index of the substance. The fourth gives the theoretical and also the experimental refractive indices. And the fifth line gives the sum of the optical refractivities of each atom.

Each collinsic shows the relation between Atomic Weight, Molecular Specific Gravity, Atomic Relative Volume, Atomic Optical Refractivity and Molecular Refractive Index.

The word "Minerals" here includes pure artificial crystalline substances, as well as natural minerals.

It is impossible for any scientist to find a flaw in the collinsics as a whole, because they all corroborate one another by means of atomic relative volume and corresponding invariable values of atomic optical refractivity. But it is possible for some one to discover a mistake in any one particular collinsic by showing that either the S.G. or the R.I. are in error.

If this event should happen to occur, the error will concern that particular collinsic alone, and will not affect the others in the slightest.

TABLE XIII.

THE COLLINSICS OF TWELVE MINERALS.

(109) Sodium hypophosphate

$$Na_4 + P_2 + O_2 + O_4 + 10H_2O$$

$$\mathbf{111.071 = 0.471(11.865_4 + 14.56_2 + 4.45_2 + 2.51_4 + 14.03_{10})}$$

$$\mathbf{111.078 = 3.865_4 + 10.51_2 + 1.747_2 + 1.346_4 + 6.572_{10}}$$

Theor. Column	Obs. Column	
1.8234	1.8233	Dufet
1.471	1.4777	CRPC

(110) Trisodium hypophosphate

$$Na_3 + H + P_2 + O_6 + 9H_2O$$

$$\mathbf{104.86 = 0.4693(11.865_3 + 5.76 + 14.56_2 + 4.45_6 + 14.03_9)}$$

$$\mathbf{104.858 = 3.865_3 + 2.613 + 10.51_2 + 1.747_6 + 6.572_9}$$

Theor. Column	Obs. Column	
1.745	1.7427	Dufet
1.4693	1.4653	CRPC
	1.4738	CRPC

(111) Disodium hypophosphate

$$Na_2 + H_2 + P_2 + O_3 + O_3 + 6H_2O$$

$$\mathbf{82.682 = 0.488(11.865_2 + 5.76_2 + 14.56_2 + 4.45_3 + 2.51_3 + 14.03_6)}$$

$$\mathbf{82.687 = 3.865_2 + 2.613_2 + 10.51_2 + 1.747_3 + 1.346_3 + 6.572_6}$$

Theor. Column	Obs. Column	
1.853	1.849	Dufet
1.488	1.4855	CRPC
	1.4897	CRPC

(112) Disodium phosphate

$$Na_2 + H + P + O_3 + O + 12H_2O$$

$$\mathbf{106.001 = 0.4463(11.865_2 + 5.76 + 14.56 + 7.53_3 + 2.51 + 14.03_{12})}$$

$$\mathbf{106.025 = 3.865_2 + 2.613 + 10.51 + 1.654_3 + 1.346 + 6.572_{12}}$$

Theor. Column	Obs. Column	
1.508	1.5139	Tann
1.4463	1.4373	CRPC

(113) Disodium phosphate

$$Na_2 + H + P + O + O_2 + O + 7H_2O$$

$$\mathbf{73.351 = 0.45503(11.865_2 + 5.76 + 14.56 + 7.53 + 4.45_2 + 2.51 + 14.03_7)}$$

$$\mathbf{73.351 = 3.865_2 + 2.613 + 10.51 + 1.654 + 1.747_2 + 1.346 + 6.572_7}$$

Theor. Column	Obs. Column	
1.6625	1.6789	Dufet
1.45503	1.4526	CRPC

(114) Sodium dihydrogen phosphate

$$Na + H_2 + P + O + O_3 + 2H_2O$$

$$\mathbf{38.433 = 0.4741(11.865 + 5.76_2 + 14.56 + 7.53 + 1.51_3 + 14.03_2)}$$

$$\mathbf{38.437 = 3.865 + 2.613_2 + 10.51 + 1.654 + 1.346_3 + 6.572_2}$$

Theor. Column	Obs. Column	
1.924	1.915	Dufet
1.4741	1.4629	CRPC
	1.48145	CRPC

(115) Sodium dihydrogen phosphate

$$Na + H_2 + P + O + O_3 + H_2O$$

$$\mathbf{31.862 = 0.4753(11.865 + 5.76_2 + 14.56 + 7.53 + 2.51_3 + 14.03)}$$

$$\mathbf{31.865 = 3.865 + 2.613_2 + 10.51 + 1.654 + 1.346_3 + 6.572}$$

Theor. Column	Obs. Column	
2.059	2.0547	Dufet
1.4753	1.4557	CRPC
	1.4852	CRPC

(116) Sodium pyrophosphate

$$Na_4 + P_2 + O_2 + O_5 + 10H_2O$$

Theor. Column	Obs. Column	
1.824	1.824	Dufet

	Theor. Column	Obs. Column	
$112.22 = 0.459(11.865_4 + 14.56_2 + 7.53_2 + 2.51_5 + 14.03_{10})$	1.459	1.4525	CRPC
		1.4604	CRPC
$112.238 = 3.865_4 + 10.51_2 + 1.654_2 + 1.346_5 + 6.572_{10}$			

(117) Disodium pyrophosphate

	Theor. Column	Obs. Column	
$Na_2 + H_2 + P_2 + O_2 + O + O_4 + 6H_2O$	1.853	1.8616	Dufet
$83.849 = 0.4708(11.865_2 + 5.76_2 + 14.56_2 + 7.53_2 + 4.45 + 2.51_4 + 14.03_6)$	1.4708	1.4649	CRPC
$83.847 = 3.865_2 + 2.613_2 + 10.51_2 + 1.654_2 + 1.747 + 1.346_4 + 6.572_6$			

(118) Wavellite $4AlPO_4.2Al(OH)_3.9H_2O$

	Theor. Column	Obs. Column	
$Al_4 + Al_2 + P_4 + O_4 + O_{18} + H_6 + 9H_2O$	2.314	2.316	D
$183.23 = 0.526(12.05_4 + 9.05_2 + 14.56_4 + 4.45_4 + 2.51_{18} + 5.76_6 + 14.03_9)$	1.526	1.526	D
$183.264 = 4.863_4 + 7.865_2 + 10.51_4 + 1.747_4 + 1.346_{18} + 2.613_6 + 6.572_9$			

(119) Turquois $AlPO_4.Al(OH)_3.H_2O$

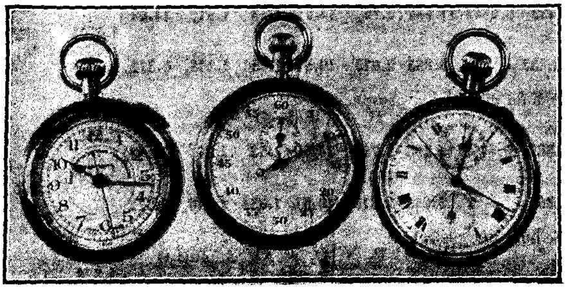
	Theor. Column	Obs. Column	
$Al_2 + P + O + O_6 + H_3 + H_2O$	2.61	2.6-2.62	D
$50.472 \; 0.6046(9.05_2 + 14.56 + 4.45 + 2.51_6 + 5.76_3 + 14.03)$	1.6046	1.61	M
$50.474 = 7.865_2 + 10.51 + 1.747 + 1.346_6 + 2.613_3 + 6.572$			

(120) Malladrite

	Theor. Column	Obs. Column	
$Na_2 + Si + F_6$	2.714	2.75	W
		2.68	Schroder
$20.82 = 0.3006(11.865_2 + 13.02 + 5.42_6)$	1.3006	1.309 N_e	W
		1.312 N_o	W
$20.82 = 3.865_2 + 11.53 + 0.26_6$			

STOP WATCHES FOR SCIENCE WORK.

The firm of A. Arnold & Co., 17, Elmcroft Avenue, Golders Green, London, N.W., have just placed on the market stop watches adequate to all general scientific requirements and, what is perhaps equally important, at prices well within the means of the most modest purse. For instance, the "Fortress" pattern, shown in left hand illustration, functions both as an ordinary timepiece and also as a stop watch, giving accurate readings to within a fifth of a second. Yet its cost is low. It is a 30-hour watch, fitted with lever movement, guaranteed for 12 months. In addition to the minute and hour hands, a centre seconds



hand is fitted, making one complete revolution per minute over a scale graduated in fifths of a second. The watch can be stopped and started by movement of a small projection on the outer rim. It is the type of timepiece the scientist will find most useful. (This watch does not have a fly back action, but another pattern is available with that additional convenience.)

The centre illustration shows Arnold's "Racing Recorder." It is fitted with lever movement and has minute and second hands only. It has start, stop, and fly back actions, bringing both hands back to zero, actuated by successive depressions of the winding knob in the ordinary way. This is a sound and reliable stop watch for general timing and testing purposes and is offered at a price considerably below that hitherto prevailing for stop watches of a similar class. Where the utmost exactitude of measurement is required, the Split Seconds Chronograph (with independent fly back action) illustrated in the right hand illustration is the pattern to employ. This watch has a 15 jewelled lever mechanism of the highest class. In addition to the ordinary hour and minute hands, stop watch minute, seconds, and fifth seconds hands are provided, these being started, stopped and re-set to zero independently.

Arnold's new pattern stop watches and chronographs can be supplied at the following prices :—

No. 1.—Arnold's "Sportsman," centre seconds stop watch, 90s. dozen, 10s. 6d. each, plus 6d. postage; guaranteed for 12 months.

No. 2.—Arnold's "Racing Recorder," guaranteed for 3 years, 25s., usual price 35s. Plus 6d. postage.

No. 3.—Arnold's chronographs, guaranteed for 5 years, £3 10s. Usual price £5.

GENERAL NOTES.

WORLD'S BIGGEST COAL DISTILLATION PLANT FOR SCOTLAND.

The Bussey Coal Distillation Company announced last week that progress in the erection of their plant at Glenboig, Glosgow, has exceeded expectations and that the works will be in full operation in early May instead of June, as formerly stated. The plant, which will treat 600 tons of coal a day, will be the largest in the world manufacturing smokeless fuel, oil and gas under a low temperature process. The entire work is being carried out by Scottish labour.

WHOLESALE PRICES IN FEBRUARY.

BOARD OF TRADE INDEX NUMBER.

As measured at the Board of Trade, the general average of wholesale prices in February was 0.1 per cent. higher than in January, the index numbers for the two months being 83.3 and 83.2 respectively (1924 = 100). Food was dearer on the average by 0.8 per cent., while industrial materials were cheaper by 0.4 per cent. Cereals were dearer by 0.9 per cent., and miscellaneous foods and meat and fish rose by 1.2 per cent. and 0.2 per cent. respectively. The index numbers for industrial materials show rises for iron and steel (0.1 per cent.) and for other metals and minerals (2.2 per cent.) and falls for cotton (2.0 per cent.), other textiles (1.2 per cent.), and miscellaneous materials (1.3 per cent.).

The average index number (1924 = 100) for all articles during the six months September to February is 83.1, the indices for those months varying only between 82.8 and 83.3.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

TWENTY-FIRST ANNUAL GENERAL MEETING.

At the Twenty-first Annual General Meeting of the Institute of Metals, held in London on March 13 and 14, 1929, the *President*, Dr. W. Rosenhain, F.R.S., presented the Report of Council for the past year.

The Report, of which the following is a summary, stated : "It is encouraging to be able to report, at this the Twenty-first Annual General Meeting of the Institute of Metals, that the membership passed the total of 2,000 at the end of 1928—the year covered by the present Report.

For an Institute such as this to have grown in twenty years from 355—the membership on December 31, 1908—to over 2,000, and to have attained in such a comparatively short space of time world-wide recognition in its particular sphere of metallurgy, is an indication that the time was ripe for its establishment. The Institute enters its third decade with every prospect of increased usefulness to the sciences and industries that it serves.

The opportunities of service to members have been increased in many ways during the past year, notably as a result of the large extension in the library and office accommodation. The new premises were in-

spected by many members on the occasion of the "House Warming" in March last. A still more important development has been envisaged recently by the Council. The proposal has been made that the Institute should co-operate in a scheme which has for its object the securing of a suitable site and building to accommodate a number of institutions and societies having somewhat similar aims, so as to secure economy by co-operation in certain services, and by the use of a common meeting-hall, library, and committee rooms.

The Membership has increased during the year from 1,903 to 2,003.

The Council has in hand arrangements for the next Autumn Meeting, to be held in Düsseldorf, Germany, from September 9-12, by the kind invitation of the Verein Deutscher Ingenieure and of the Deutsche Gesellschaft für Metallkunds. Steps are also being taken in connection with the visit of the Institute to America in 1932.

It was possible, as a result of sums accumulated on deposit account over a lengthy period, to add to the permanent investments during the past year 5 per cent. War Stock to the value of £1,000, thus raising the Institute's invested funds to £4,986.

Synopses of Papers
Presented at the Twenty-first Annual Meeting.

Special Properties of Eutectics and Eutectoid Alloys in Binary Metallic Systems. By Professor P. Saldau, Member, Mining Institute, Leningrad, Russia.

(1) The hardness and electrical resistance of a number of eutectic alloys have been studied, and it is shown that the eutectic occupies a special and abnormal position on the property-composition curve, even in drastically annealed alloys.

(2) It is pointed out that for coalesence to occur in eutectic alloys, an excess of one of the phases is necessary.

(3) Polymorphic changes in some of the constituent metals of the system have been studied.

Work-Softening and a Theory of Intercrystalline Cohesion. By F. Hargreaves, A.R.S.M., D.I.C., F.I.C., Member (Assistant Chemist, Southern Railway, Ashford), and R. J. Hills, Member (Chemical Assistant, Southern Railway, Ashford).

Further investigation on work-softening has led to the establishment of the conditions necessary for its occurrence. They are (a) the presence of more than one phase; (b) probably *both* constituents must have the property of undergoing spontaneous annealing after working at air temperature.

A theory of intercrystalline cohesion is outlined. Briefly, it postulates the existence of a transition zone between two orientations. This is not to be regarded as amorphous metal, for, given the same two orientations and the same relative position of the boundary, the same pattern of atomic arrangement is always found in the unstressed metal.

The conditions respecting the effect of stress and recovery are considered. Boundaries between different phases are discussed, and some of the differences to be expected are pointed out.

The cause of "creep" is attributed essentially to boundary action, and facts are given which indicate that the origin of fatigue is to be sought at the boundaries.

Work-hardening and work-softening are shown, it is claimed, to be identical phenomena concerning the early stages of the latter. The cause of the very pronounced softening by heavy working is attributed to interphase boundary action and the retention of the individual phases in a quasi-viscous condition.

Other phenomena are considered in relation to the theory.

Note on the Testing of Electro-Deposits on Aluminium. By G. B. Brook, F.I.C., Member (Chief Chemist, British Aluminium Co., Ltd.), and George H. Stott, B.Sc., A.I.C., Member (Research Analytical Assistant, British Aluminium Co., Ltd., Kinlochleven.)

The work outlined in the above paper represents investigations carried out during the past year on a considerable number of samples of commercial electroplating on aluminium. Most of these were finished in nickel as being the commonest metal used for securing a finish in general commercial practice. The contribution is not concerned with the actual plating of the material, but is confined to the development of a test, or tests, which indicate the stability of the deposit; it is rather from the user's than from the producer's standpoint that the tests have been evolved.

(*To be continued.*)

SOCIETY OF PUBLIC ANALYSTS.

Papers read on March 6 :—

The Alkaloid Test for Tannin. By Christine Mary Fear, B.Sc. (Work done under the Analytical Investigation Scheme).

It has frequently been asserted that most

alkaloids are precipitated by tannin, but the author's experiments show that the only alkaloids giving appreciable precipitates with tannin solutions alone are brucine, caffeine, cinchonine, cinchonidine, quinine and strychnine. Hence the assumption that alkaloids are a general reagent for the tannins requires modification.

The Cryoscopic Method for the Detection of Added Water in Milk. By A. L. ANDREW.

The determination of the freezing point affords a simple and reliable means of detecting added water in milk. The results of thousands of determinations, extending over 17 years, has shown that genuine milk has a freezing point not higher than −0.550° C., when determined by the method in use in the New Zealand Dominion Laboratory. If the freezing point rises to −0.530° C. watering may be suspected, and if to −0.520° C., the milk has certainly been adulterated with 5 per cent. of added water.

Investigations on the Relations Between the Acidity and Freezing Point of Milk. By A. J. PARKER AND L. S. SPACKMAN.

Determinations of the variations of the freezing points of milk with increasing acidities have been made on samples, both unadulterated and containing definite amounts of added water. The value of 0.20 per cent. acidity, given by the *Connecticut Agricultural Experiment Station, 27th Report on Food Products* (1922) as the normal acidity of fresh milk is criticised, and a value of 0.14 per cent. is suggested as being nearer the truth. The correction factor of 0.003° C. for each 0.01 per cent. excess acidity is shown to hold between acidities of 0.17 per cent., and 0.60 per cent., and a value of 0.010° C. has been suggested for acidities ranging from 0.14 to 0.17 per cent. lactic acid. Results with milks containing added water are tabulated which tend to show that when the cryoscopic method is used for the determination of added water in milk, it can be applied with accuracy only when the samples are quite fresh.

ROYAL AGRICULTURAL SOCIETY.

March 6.

Mr. H. Dent Brocklehurst presented the Chemical Report which had been received from Dr. Voelcker :—

REPORT OF CONSULTING CHEMIST.

Enquiries have been pursued with regard to two matters reported to the last meeting :

" Chilian Peas " containing a glucoside producing prussic acid on fermentation, and found to be the cause of death of pigs.

It has been ascertained that these do not come from Chili (S. America), as at first believed, but that they are imported from the province Chihli, in N. China, and should be described as " Chihlian " peas. The exact botanical name for them has not been ascertained, but a correspondent tells me that they were known to him some years ago under the name " rich man's chow," and, after cooking, were used as human food.

" Federal Barley."—Evidence continues to accumulate as to the very unsatisfactory nature of foreign barley sold under this name. Further, it has been ascertained that it is to a particular grade known as " Federal Barley No. 2," and sent over to this country in 1928, that the troubles in pig-feeding that have been recorded have, in the main, been due.

In a case reported to me, in which pigs had died and where I found the barley meal to be very impure, I subsequently heard from the owner that he had followed my advice, had the parcel changed for home-grown barley meal, and had experienced no trouble since.

Mr. H. Dent Brocklehurst moved the adoption of the report. He was sorry to say that Dr. Voelcker had been ill for some time, and was unable to attend the meeting on the previous day. He was glad, however, to say that Dr. Voelcker was now very nearly well, and, judging from his last letter, he hoped that he would soon be restored to his usual health.

The report was adopted, as were the Botanical and Zoological reports.

SOCIETY OF GLASS TECHNOLOGY.

March 20.

The following papers were read :—

The Distribution of Temperature in Glass Tank Furnaces. By E. A. COAD-PRYOR, B.A.

The Selection of Coal for Gas Producers. By E. J. C. BOWMAKER, B.Sc., AND J. D. CAUWOOD, M.Sc.

ROYAL SOCIETY OF EDINBURGH.

NEW FELLOWS.

The Council of the Royal Society of Edinburgh has awarded the Gunning Victoria jubilee prize for 1924 to 1928 to Professor E. T. Whittaker, F.R.S., in recognition of his distinguished contributions to mathematical science, and of his promotion of mathematical research in Scotland; and the

Makdougall-Brisbane prize for 1924 to 1928 to Dr. William Ogilvy Kermack, for his contributions to chemistry, published in the Society's *Proceedings* and elsewhere.

The following have been elected Fellows : Dr. S. G. Barker, Director of Research, British Research Association for the Woollen and Worsted Industries, Leeds; Dr. F. Bath, Lecturer in Mathematics, University of St. Andrews; Mr. G. Bennet, Lecturer in Mechanical Engineering, Heriot-Watt College, Edinburgh; Dr. A. Calder, Assistant in the Animal Breeding Research Department, The University, Edinburgh; Dr. G. Coull, Pharmaceutical Chemist, Leith; Professor E. W. H. Cruickshank, Physiology Department, Dalhousie University, Halifax Nova Scotia; Mr. David Kennedy Fraser, Psychologist to the Education Authority, Glasgow; Mr. T. Henderson, Actuary of the Savings Bank of Glasgow; Dr. Sunder Lal Hora, Senior Assistant Superintendent Zoological Survey of India, Calcutta; Professor J. Kendal, F.R.S., Chemistry Department, University of Edinburgh; Mr. J. R. Little, General Manager and Secretary of the Century Insurance Company, Edinburgh; Professor D. N. M'Arthur, Department of Agricultural Chemistry, West of Scotland Agricultural College, Glasgow; Mr. J. Mackie, Mathematical Master, Leith Academy, Leith; Mr. W. Mercer, Lecturer in Clinical Surgery, University of Edinburgh; Mr. H. Moir, President, United States Life Insurance Company, in the City of New York; Professor F. W. Ogilvie, Department of Political Economy, University of Edinburgh; Dr. J. F. V. Phillips, Botanist in Government Service, Tanganyika Territory; Mr. S. Read, Shoolmaster, Edinburgh Academy; Mr. R. A. Robb, Lecturer in Mathematics, University of Glasgow; Principal J. C. Smail, Heriot-Watt College, Edinburgh; Professor Sydney Smith, Department of Forensic Medicine, Edinburgh University; Dr. Thomas Southwell, Lecturer in Helminthology, School of Tropical Medicine, Liverpool; Mr. A. C. Stephen, Assistant, Natural History Department, Royal Scottish Museum, Edinburgh; Dr. B. P. Wiesner, Lecturer in Sex Physiology, University of Edinburgh.

CORRESPONDENCE.

(*To the Editor of the* Chemical News.)

Sir,—The recent rise in the price of petrol has provoked much speculation as to the future of the 4d. a gallon duty on imported petrol imposed by the last Budget.

There appears to be a divergence of views as to whether the petrol tax should be withdrawn or substantially increased as an alternative to the horse-power tax. It is to be hoped that the public will not lose sight of the fact that the petrol duty was designed as a preferential tax upon imported oils with the specific object of encouraging the production of British motor spirit. The duty has, in fact ,proved a direct stimulus to the investment of public money in this new British industry, and the foundations are now being laid of what will undoubtedly prove to be a highly important business of considerable magnitude.

While one has every sympathy with the complaint that the motor industry has been badly hit at a critical season of the year, it must not be forgotten that any hasty adjustment of taxation, prejudicial to British petrol interests, would have the most serious effect on the future of coal petrol, without radically altering the petrol position.

So long as this country depends upon foreign supplies for its commercial, naval and military petrol, prices will be determined by the importers and suppliers, and I am not suggesting that their prices are regulated by anything other than the just needs of the foreign oil position.

It must not be forgotten that as the supplies of crude oil begin to fall off—as they may do in the lifetime of many of us to-day —the price of petrol in this country may easily rise to 20s. per gallon. It is hardly likely that the foreign producer will worry about sending his diminishing stocks of vital fuel to this country, and national needs will dictate a policy forbidding export altogether.

I submit that the true economic answer to the petrol rise is the active encouragement by the public and the Government of the low temperature carbonisation of our coal supplies, so that the Britist coal-petrol industry (in the establishment of which British capital has now been invested) may be developed with the utmost rapidity. Such encouragement will not only bring prosperity to the mines ,and relief to the distressed coal areas, but it will also introduce a new and powerful element of competition into the petrol market. It will also ultimately save this country, when serious shrinkage in the world's oil output stops the flow of foreign-produced oil to these shores.

Yours faithfully,

W. A. Bristow.

12 March, 1929.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Tuesday, March 26, at 4.30 p.m.—Dominions and Colonies Meeting.—H. Warington-Smyth, C.M.G., M.A., F.G.S., M.I.M.M., late Seretary for Mines and Industries, Union of South Africa : "The Base Metal and Mineral Resources of South Africa."

ROYAL INSTITUTE OF PUBLIC HEALTH.

CONGRESS AT ZURICH, MAY 15 TO 20, 1929.

The forthcoming conference at Zurich will be an affair of international interest and importance. The different sections, under which papers will be discussed are, State Medicine and Municipal and Social Hygiene; Industrial Hygiene and Industrial Diseases; Child Welfare, School Hygiene and Women and Public Health; Pathology, Bacteriology and Biochemistry; Tuberculosis; Climatology and Sports Hygiene; Veterinary Medicine and Meat Hygiene; and General Information.

BALE FAIR, 1929.

The Thirteenth Annual Swiss Industries Fair, which opens at Bâle for ten days on April 13, shows a notable increase on previous years both in the number of exhibitors and in the range of national industries and crafts represented.

Some 1,500 exhibitors have booked floor space.

The industries to be represented have been grouped into the following sections :—Chemistry and pharmacy, domestic articles, dwelling house equipment, musical instruments, sports goods and toys, watches and jewellery, applied arts and ceramics, office equipment and furniture, paper, publicity, publishing and graphic arts, textile and clothing, footwear and leather goods, technical goods, inventions, patents, electrical trade, machinery and tools, transport, natural produce and raw materials.

The Chemistry and Pharmacy group, comprising pharmaceutical preparations, toilet articles and cosmetics, is well represented. It is also noteworthy that this year a number of the leading chemical works in Switzerland are staging comprehensive exhibits showing the application of aniline dyes in the textile trades.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

6,291.—Galardi, A. N.—Production of hydrocyanic acid. February 26.

6,303.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of 2 : 3 hydroxynaphthoic acid. February 28.

6, :565.—I. G. Farbenindustrie Akt.-Ges. —Separation of mixtures of sulphuric acid and nitric acid. February 28.

6,155.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 2-mercapto-arylenethiazole compaunds. February 25.

Specifications Published.

306,563.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges). — Production of hydroxyalkylamines.

306,575.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges).—Process for the manufacture of ortho-cyanarylthioglycollic acids and intermediate products.

306,607.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges).—Process for the manufacture of ortho-cyanarylthioglycollic acids and intermediate products.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

303,917.—Sulphonic acids.—Johnson, J. Y. 47, Lincoln's Inn Fields, London.—(I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.)

Sulphonic acids useful as wetting, emulsifying, or cleansing agents are obtained from unsaturated aliphatic hydrocarbons or their halogen derivatives or from unsaturated hydro-aromatic compounds by treating them with sulphonating agents, such as sulphonic acid, sulphur trioxide, and or chlorsulphonic acid, and an equimolecular amount or more of an organic acid, acid anhydride, or acid chloride or of phosphoric acid or its anhydride or chloride. The re-

action may be applied to the individual hydrocarbons or compounds or to mixtures containing a preponderating proportion thereof, such as petroleum or its cracking products or brown-coal tar oils such as gas oil, yellow oil, and solar oil; such mixtures may be treated directly or after enriching or isolating their olefine constituents. In one example, tetrahydrobenzene is treated with a mixture of sulphuric acid and acetic anhydride and the reaction product is diluted with water, heated to remove acetic acid, and neutralised. Derivatives of unsaturated hydroaromatic hydrocarbons, such as the corresponding naphthenic acids, may be treated in the same way. In another example, propylene is led into a mixture of sulphuric acid and acetic anhydride and the mixture is allowed to stand. The reaction product so obtained is worked up by diluting with water, boiling under reflux, and distilling off acetic acid. The sulphonated propylene can be recovered from the solution as calcium or sodium salt. Higher homologues of propylene or halogen derivatives of the olefines such as trichlorethylene may be treated in the same way.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BISMOID BRAND.

497,279.—Chemical substances prepared for use in medicine and pharmacy.—H. R. Napp, Limited, 3 & 4, Clements Inn, Kingsway, London, W.C.2. March 6th.

" EVOLUTION DISPROVED."

By Rev. W. A. Williams, D.D.

Obtainable from *The Chemical News*. Price 5s.

PERIODICALS FOR SALE.

Advertiser has a stock of back numbers of Scientific Periodicals which he is willing to sell at one-third published price, or less. Typed list sent on receipt of 1½d. stamp.—Write, G. D., c/o *Chemical News* Offices.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager, The Chemical News, *Offices*: Merton House, Salisbury Square. London, E.C.4.

THE CHEMICAL NEWS AND JOURNAL OF INDUSTRIAL SCIENCE.

Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices: Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO., 10, Rue de Bretagne ASNIERES (Seine) FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3598.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Reproduction of Natural Colour 193
By Robert Saxon.
Analysis of Photographic Emulsion ... 195
By Shiro Matsumaye.
Deposition of Radium and Other Alkaline Earths at the Dropping Mercury Cathode 195
By J. Heyrovsky and S. Berezicky.
Studies on the Crystallisation of Paraffin. II. 198
By Y. Tanaka, R. Kobayashi and S. Ohno.
General Notes 199
Proceedings & Notices of Societies :—
Institute of Metals 187
Society of Glass Technology 203
The Optical Society 205
Geological Society 205
Notices of Books 206
Forthcoming Events 207
New Patents 207
New Trade Marks 208

REPRODUCTION OF NATURAL COLOUR.

By ROBERT SAXON, B.Sc., F.C.S.(Lond.), M.S.Chem.I., M.Amer.C.S.

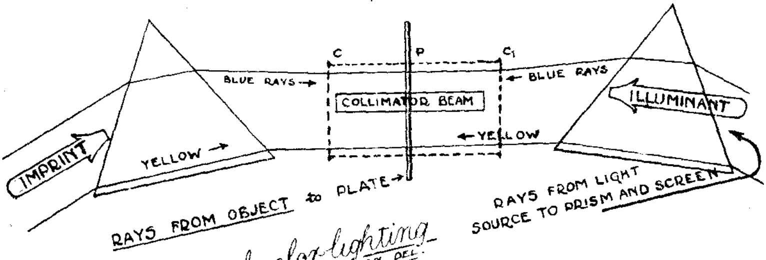
This has reference to the colouring of images thrown on the screen to represent naturally coloured objects taken by camera. In colour photography many attempts have been made by Lippmann, Butler, Joly, Johnson, and a host of others to prepare screen or filter negatives for two colours, or three, to print with coloured inks as in lithography using the proofs obtained from these negatives as guides, as near to nature as any subsequent process, but none of these have sought to find a means of illuminating a cinema screen by colours not dependant on inks or pigments but on natural or artificial light sources. The usual coloured picture on the cinema screen is too high in tone, too flat in its washes, too overlapping in the same, too vivid in its greens and reds, and too metallic opaque in its darks. In addition to these drawbacks it is never sufficiently well lit to bring out detail, and is only clear in the "close ups." Beautiful scenery is depicted usually as a meaningless mosaic. In "close ups" highly coloured parts of dress, such as scarves, flowers, etc., are dragged in to bring in contrast necessary to definition. All this would not be if pigments never perfectly transparent were not used to reproduce colour, but instead the colours produced by the analysis of white light.

If rays from a spot coloured blue be allowed to impinge on a prism they will be refracted and may be allowed to fall upon a photographic plate. At the same time a beam from a yellow spot may be constrained to travel in a direction parallel to the first, it will be refracted also, at its angle of deviation, and impinge on the plate. From such a plate a screen filter can be made, capable of letting light through in intensity proportional to the intensities of the sources. A second prism, as shown, may be arranged to send along the paths blue and yellow, in reverse direction, through such a filter, having now intensities in keeping with the original beams, to illuminate a picture screen. In the illustration the beams are shown very wide apart, for purposes of easy draughtmanship, but in reality, if the original coloured spots were on the same point, the respective beams would take their respective paths, and impinge on different parts of the plate. The illuminating beams would do the same with the filter in the reverse sense, and produce the original blend of the two colours on the spot from which they set out. If now the second prism be set by experiment or calculation, to "reverse" the first, using white light as illuminant, no matter the colour, that colour will be sent back, through the spot on the filter which that colour hit in the first case. Should white light be used at both ends as illuminant, positions for the various parts can be arranged by trial, using a fine opal screen in the place of the plate.

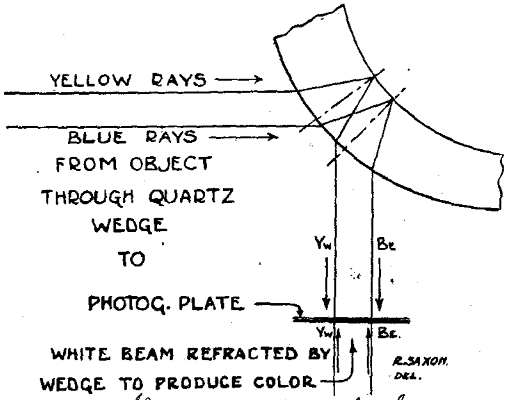
In the figure the coloured objects are assumed to be on the left, and their reflected lights travelling in a collimator to the prism. The illuminator is on the right, sending its

beams through a similar collimator. Much abberation occurs, with great difficulty of focus, in consequence of the thickness, varying thickness, of the prisms. There is also loss of intensity from the same cause. For that reason a wedge called by the author a "Sinoflex Wedge," made of quartz, is immensely superior to prisms. Great dispersion can be obtained with very thin wedges.

The wedge is shown much thicker than it need be, again for purposes of draughtsmanship, and clarity. An ordinary quartz wedge is supposed to be curved (Latin *sinus*, curve) as shown. Such a shape gives dispersion without the necessity of the rays traversing much quartz, and depending on the curvature, this dispersion can be got by taking less radius. The thing to avoid is interference by reflected rays from the lower curve. The dispersion can be varied considerably by altering the point of impact on the outer surface. The working in the second illustration is similar to that with prisms, but focussing is much more satisfactory.



Natural color lighting



The reproduction of color.

THE ANALYSIS OF PHOTOGRAPHIC EMULSION.

By SHIRO MATSUMAYE.

(*Japanese Society of Chemical Industry.*)

Various methods were tried for the determination of silver, iodine and bromine in photographic emulsions. The Eggert method of extracting the dry plate with cyanide solution and estimating the residual free cyanide by titrating with the standard $AgNO_3$ solution, Kl serving as an indicator, was found giving satisfactory result for the total silver content of the dry plate. But the separate estimation of halogens suffers inaccuracy, and there are difficulties in the way of obtaining accurate results. The difficulties lie in the incompleteness of reduction of the iodo-bromide of silver into soluble halides and free silver. Several new methods but were found unsatisfactory. These included: reduction of the silver halides by molten zinc, the electrolytic reduction, the reduction by molten sodium, the reduction by zinc dust in a current of hydrogeu, and so forth.

At last, Clark's method was adopted with small modifications. The dry plate was extracted with potassium cyanide solution, the solution was boiled with zinc for one hour, the cyanide was decomposed with acetic acid, hydrocyanic acid was expelled with carbonic acid. The reduced silver was dissolved in nitric acid and titrated with thiocyanate. The mixed solution of iodide or bromide was titrated electrometrically with $AgNO_3$ after the addition of barium nitrate. The result gives the total silver, iodide and bromide of silver, the free (adsorbed) bromide, and the chloride if present. It also indicates the presence or absence of an appreciable amount of sulphate, perhaps in the form of alum, giving a white precipitate with barium nitrate.

The author gives his experiences of the amounts and method for removal of any chloride which may be present in the chemicals used, such as potassium cyanide, barium nitrate, etc., and which may interfere with the analysis.

—Department of Applied Chemistry,
Faculty of Engineering, Tokyo Imperial University.

THE ENGINEERING INDEX SERVICE INDEXES THIS JOURNAL.

This Journal is fully indexexd—every issue, as soon as published—in a set of cards, which thus brings ready to your hand any article on any subject in this Journal or in any one of 1,700 other journals in all languages. This Engineering Index Service, instituted in January, 1928, is to be found in the Public Libraries of Newark, Cleveland, Bridgeport, Baltimore and the John Crerar Library, Chicago.

Engineers in any field who live or work in New Jersey will find this mammoth index to the Latest Engineering Literature, in the Public Library of Newark, N.J., which has this Journal on file. The Library is open daily from 9 to 9.30. It is convenient to all railroad stations. It answers inquiries by mail or by telephone.

THE DEPOSITION OF RADIUM AND OTHER ALKALINE EARTH METALS AT THE DROPPING MERCURY CATHODE.*

By J. HEYROVSKY AND S. BEREZICKY.

(*Continued from Page* 184).

SOLUBILITY DETERMINATIONS.

Since the polarographic method enables us to estimate traces of reducible matter in solution down to concentration 10^{-5} to 10^{-6} molar, it is especially apt for the investigation of solubilities. Against the very sensitive conductance method it possesses the advantage that even in presence of great excess of other electrolytes the concentration of small quantities of certain ions is determinable.

This may be tested on sparingly soluble salts of barium, strontium, and calcium.

Barium.—The least soluble compound of barium, *viz.*, its sulphate, was precipitated from a centinormal solution of its chloride by a centinormal solution of potassium sulphate and the precipitate washed many times by decantation during a week, and finally rinsed with water an a filter. All the other precipitates investigated below were prepared similarly. The precipitate was then suspended in a centinormal or a millinormal solution of lithium chloride and gave on polarographic investigation, when air was expelled from the solution by hydrogen and the maximal sensitivity of the galvanometer was used, invariably a "wave" 14 mms. high, even after one week standing. Fig. 4 curve 1 shows this "wave," whilst curve 2 represents, for comparison, a barium wave du eto a $4.10^{-5}n$ concentration of barium chloride in a centinormal lithium chloride solution obtained with the same rate of dropping. The two waves are in a ratio of approximately 3 : 4; also the absolute height, 14 mms., indicates the concentration of barium ions as $3.10^{-5}n$.

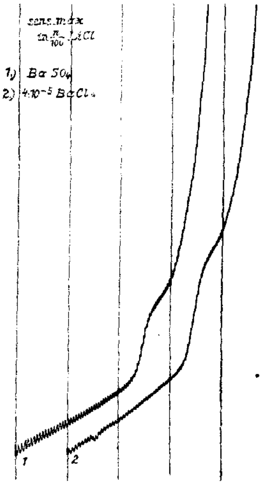


Fig. 4.

Thus the solubility of barium sulphate in a centi- or millinormal solution of lithium chloride is 3.10^{-5}*gr eq.* per litre. The solubility of barium sulphate in pure water is found to be at 18° C. 2.10^{-5} *gr*-equiv. per litre (comp. Kohlrausch *Z. physikal. Chem.*, 1908, LXIV, 121) and known to increase with additions of electrolytes (from A. Seidel's Solubilities, 1922 and 1927).

When the barium sulphate is suspended in pure water, the wave due to the barium deposition is much greater; however, in extreme dilutions the dimensions of the "waves" are very sensitive to traces of other electrolytes, *e.g.*, to those coming from the dissolution of glass, which makes the exact evaluation of the very small solubility of barium sulphate in pure water difficult and uncertain.

The ageing effect upon the solubility of barium sulphate shows the solubility of the freshly precipitated barium sulphate is about 8 times greater than that of the 30 hours old precipitate. The barium carbonate, on the other hand, is considerably more soluble in water, giving a distinct wave of dimensions due to concentrations between 5 and 6.10^{-4} *n*

Strontium and calcium.—From sparingly soluble salts of strontium the solubilities of the sulphate, carbonate, and oxalate were investigated.

MIXTURES AND ANALYTICAL APPLICATIONS.

The differences in the deposition potentials of alkaline earth metals are great enough to allow us to follow the deposition of each of them in their mixtures.

Thus traces of radium will be noticeable in any amount of strontium and calcium, even in the presence of alkalies; it becomes, however, indistinguishable when the ratio of barium to radium exceeds 10 : 1.

Traces of barium are discernable in solutions of all alkalies and alkaline earths.

Small quantities of strontium may be followed only in solutions of calcium and lithium, which have the most negative deposition potentials. Strontium is, however, masked by sodium, potassium and magnesium. In great excess of barium the strontium disappears in the barium "wave."

Titrations.—A considerably higher accuracy in quantitative determinations is obtainable where polarographic titrations may be applied. The end point of the titrations may be obtained from the height of the "wave" when a sparingly soluble salt is precipitated. In the solutions to be titrated chlorides, bromides, iodides or hydroxides may be used, but no nitrates, since they are reduced above 1.5 volt of polarisation. From the above experience it is evident that barium can thus be titrated in excess of all the other alkaline earths or alkalies (excepting radium); strontium only in the presence of less base metals; for calcium a method has been applied, which is not hindered by other electrolytes, so long as they do not exceed the concentration of calcium ions. To avoid adsorption and occlusion in the formed precipitates and quick ageing, it is preferable to dilute the solutions, to be titrated, to a concentration about millinormal and to titrate them by a centinormal solution.

The titrations were all carried out with solutions standing open to air; it has been found that at −2 volts polarisation all oxygen in solution is reduced to water and causes only a constant diffusion current, which with a $^1/_{10}$ sensitivity does not interfere with the deposition of the alkalies and alkaline earths metals.

The polarogram, Fig. 5, stands as an example of this sort of titrations (comp. *Bull. Soc. Chim.*, 1, c. 1288).

Carbonates, like sulphates, may be used to titrate barium (comp. Fig. 5); here owing to the greater solubility of the carbonate, the second diminution of barium "waves"

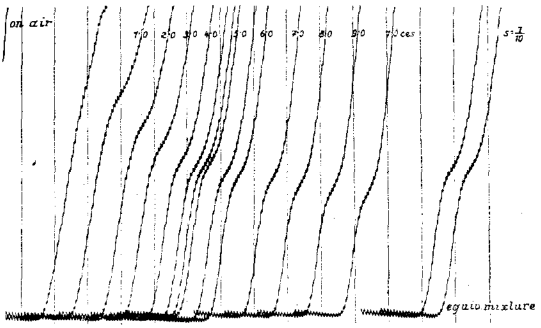


Fig. 5.

by the excess of carbonates is less marked. Again, two curves of the " equivalent mixture " are added for comparison, the first taken just after mixing, the second 4 minutes later, showing that no effect of ageing is observable.

Solutions of strontium have to be titrated by lithium carbonate, since the deposition of other alkali-carbonates would cover on the curves the deposition of strontium ions. Lithium, as has been pointed out above, has next to calcium at the dropping mercury cathode the most negative deposition potential and thus does not interfere with the deposition of strontium.

The limits of the precision of the polarographic method.—The limits of this method, if the sensitivity of the galvanometer is about 5×10^{-9}, depend on the experience that $10^{-5}n$ ionic concentrations may still be estimated within 10 per cent., and that 2 ccs. suffice for the determination. Thus 2×10^{-8} *gr.-equivalents may be estimated*, or, if the equivalent weight varies from 10 to 100, 0.0002 to 0.02 milligram determined with a 10 per cent. accuracy. The probable error in the end point determination of titrations is ± 0.1 cc. when a centinormal solution is run into 50 ccs.

The authors wish to express their indebtedness to the Board of Education (Ministerstvo skolství a národní osvety) for the radium specimen kindly for these investigations and to the authorities of the Ministry of Work (Ministerstvo verejnych prací) for the quick delivery of the required fresh radium specimen, willingly tested in the State Radiologic Institute (Státní Radiologicky Ustav).

SUMMARY.

1. The " deposition potentials " from normal ionic concentrations are estimated for

Ra : $-1.718v$, Ba : $-1.761v$, Sr : $-1.964v$
Mg : $-1.669v$, Ca : $-2.047v$,

from the normal calomel zero.

2. From the magnitude of the diffusion *currents radium may be followed quantitatively* in mixtures with barium from the ratio Ra : Ba as 1. 10 till 25 : 1 in concentrations 10^{-4} molar, :2 ccs. of the solution being necessary. Traces down to 10^{-5} *gr.-eq.* per litre of radium or barium are determinable in the same way in any amount of alkalies or alkiline earths; strontium only in mixtures with the alkaline earths or lithium.

3. The applicability of the polarographic method for the determination of solubilities of sparingly soluble salts has been tested.

4. The deposition of magnetism and beryllium even from very small concentrations is accompanied by an evolution of hydrogen; owing to this action small amounts of magnesium may be roughtly estimated.

5. " *Adsorption currents* " with well defined maxima are best shown on current-voltage curves of solutions of the heavy alkaline earths.

6. Examples are given of polarographic titrations of barium, strontium and calcium ions.

From the Physico-Chemical Institute
of the Charles' University, Prague.

STUDIES ON CRYSTALLISATION OF PARAFFIN. II. CRYSTAL SYSTEM OF PARAFFIN FROM SHALE OIL.

By Yoshio Tanaka, Ryonosuke Kobayashi and Sadayuki Ohno.

The authors have described the relations between crystal forms of shale paraffin and crystallising conditions, and found that the fundamental form of paraffin was an ortho-rhomb, and that the other complicated forms were derived from the rhomb by parallel growth.

In this paper, the determinations of the crystal system of the fundamental rhomb and the other forms of shale paraffin are described. The results are summarised as follows:

(1) The ortho-rhombic plate of shale paraffin crystallised from alcoholic solution was examined optically. Each pair of its angles were 110° and 70° and also a double refraction and parallel extinction were observed. When the analyser was rotated, the interference figures showed that the three crystal axes were parallel to the three vibration axes one another, that is, this crystal belongs to rhombic system.

(2) Other plate forms of paraffin belong also to rhombic system and are considered to be produced by parallel growth of the fundamental rhomb.

(3) Needle crystal of paraffin is also obtained by a continuous parallel growth of the ortho-rhomb to the direction of 70° angle. It shows the same optical characters as the plate forms. A marked difference of optical axial angles in plate and needle crystals may be considered as a result that needle form was produced by parallel growth of plate forms.

(4) Needle form of paraffin from melted state belongs optically to rhombic system.

INDUSTRIAL REORGANISATION.

Summary of Recommendations of Joint Interim Report Adopted on March 12.

1. A comprehensive enquiry into the consolidation of existing pensions and insurance funds should be immediately set up by the Government.

2. Funds for assisting emigration should be large increased and found by loan instead of out of revenue. These funds should be under the control of a committee of representatives of industry under the chairmanship of a minister and similar committees should be set up in the Dominions. A programme extending over a period of twenty years should be aimed at in the scheme of settlement. Emigration by groups or community should be undertaken. Emigration policy should be co-ordinated by a Joint Committee for the British Commonwealth with representatives of employers and Trade Unions upon it.

3. Unemployment in the mining industry should be considered as a special case and relief measures and schemes should be continued at an accelerated rate.

4. Orders for government and municipal departments should be placed in this country under properly regulated and co-ordinated conditions.

5. Trade facilities should be reinstituted under more liberal conditions.

6. A Crown Colonies Development Committee should be formed for purposes of development and the placing of orders for plant in Britain.

7. Export credits should be extended in reasonable cases in order to achieve the greater stimulation of immediate purchasing power.

8. Augmented pensions out of national insurance and pensions fund should be made available to workers of 65 and over who cease work, such pensions to be supplemented by employers when conditions permit.

9. The Government should create and maintain a Development Fund capable of financing important national schemes.

0. Further extension of constructional schemes of a permanent character should be undertaken and existing schemes hastened in their application.

11. Rationalisation in the widest sense of the term should be pressed forward as rapidly as possible involving consultation with Trades Unions. The changes involved in rationalisation should be introduced gradually and the Trade Unions should be consulted as to the best method of dealing with displacement. Firms or industries, where possible, should set up a Labour Reserve Fund out of profits to assist displaced workers.

12. Means should be explored for establishing a more authoritative contact between agriculture and industry.

13. Serious consideration should be given to the question of raising the school leaving age.

14. A Government enquiry into currency and banking policy, to be participated in by representatives of industry and finance should be undertaken immediately.

INTERNATIONAL OIL, CHEMICAL & COLOUR TRADES EXHIBITION.

The second International Oil, Chemical and Colour Trades Exhibition was held at the Royal Agricultural Hall, London, from Saturday, March 16 to Saturday, March 23.

The Oil, Chemical and Colour trades form a highly important branch of British Industry, and it is abundantly clear from the very representative displays in each section that British manufacturers are not lacking in enterprise. The displays included a very comprehensive range of the various grades of fuel, industrial and edible oils, petroleum, chemicals and colours, coal-tar products, fertilisers, soaps, waxes, etc., as well as all the latest inventions and developments in the way of manufacturing plant, machinery and accessories.

The exhibition has been organised by the International Trade Exhibitions, Ltd., who have been responsible for over one hundred exhibitions in the past thirty years. An Honorary Advisory Committee, composed of prominent men in the oil, chemical, colour and engineering industries, and strongly representative of the various interests concerned, has rendered valuable assistance in creating a trade exhibition of a very high order which serves to prove that British manufacturers are by no means so apathetic as the pessimists would have us believe.

U.S. EXTERNAL TRADE.

The external trade of the United States in 1928 is the subject of a *Review* by Mr. A. J. Pack, issued by H.M. Dept. of Overseas Trade (1s. 6d.) It is pointed out that the American exports amounted to 4,877 million dollars in the year ending June, 1928, and there was a favourable balance over imports of 731 million dollars. Attention is directed to fluctuations in the price of certain raw materials. The United Kingdom still heads the list of countries importing goods from America and Canada comes second. American chemical industries continue to make rapid progress and the export trade for the last fiscal year was 192,500,000 dollars, representing an increase of 152 per cen t. on pre-war exports.

GENERAL NOTES.

MERCHANDISE MARKS ACT, 1926.

ENQUIRIES.

The Standing Committee (General Merchandise) appointed by the Board of Trade will hold Enquiries in due course as to whether the under-mentioned classes and descriptions of imported goods should bear an indication of origin :—

(1) Glassware, including Bottles, Jars, etc., and Tubing and Rod. (2) Wireless Receiving Sets, Components & Accessories. (3) Vacuum Cleaners. (4) Hosiery and Knitted Goods. (5) Bricks and Tiles. (6) Implements and Tools. (7) Steel Nails. (8) Wood Split Pulleys. (9) Portland Cement. (10) Asbestos Cement Products. (11) Artists' and Drawing Materials, etc. (12) Fountain Pens and Propelling Pencils, etc.

No date has yet been fixed for any of these Enquiries, but communications should be addressed to the Secretary of the Committee, Mr. E. W. Reardon, Board of Trade Offices, Great George Street, London, S.W.1.

OCCUPATIONS OF BRITISH MIGRANTS.

Details are presented of the occupations recorded as followed by emigrants from and immigrants into Great Gritain and Northern Ireland during 1928. Figures for the previous year are also provided for comparison. On balance the net loss of adults in 1928 was greatest in skilled trades—32 per cent. of the total net loss, and in the agricultural group—31 per cent.

INTERNATIONAL CONGRESS ON VINEYARDS AND WINE.

The Department of Overseas Trade is informed that on the occasion of the International Exhibition at Barcelona, au International Congress on Vineyards and Wine will be held.

Communications should be addressed to the Organising Committee of the Congress at Calle de Ferraz 19, Madrid.

MOTOR CYCLES IN NEW ZEALAND.

H.M. Trade Commissioner at Wellington reports that 39,690 motor cycles were registered in New Zealand as at 31 December, 1928.

MOTOR VEHICLES IN CEYLON.

The number of motor vehicles in use in Ceylon on 31 December, 1928, according to figures received from H.M. Senior Trade Commissioner in India, were as follows :—Cars, 11,228; taxi-cabs, 1,431; omnibuses, 2,314; lorries, vans, etc., 2,338; tractors, 21; and trailers, 101.

CANADA'S TRADE WITH THE UNITED KINGDOM.

The total value of imports for consumption from the United Kingdom into Canada during January last was 15,442,831 dollars, while Canadian exports to the United Kingdom reached a total of 18,431,500 dollars, states the Dominion Bureau of Statistics, Ottawa. The totals for the twelve months ended January were 193,451,484 dollars and 445,031,841 dollars respectively.

THE CZECHOSLOVAK GLASS INDUSTRY.

The glass industry in Czechoslovakia has had a satisfactory year, the production showing an improvement in both volume and value. In spite of increased competition in the world's markets exports rose from 173,708 tons in 1927 to 206,302 tons in 1928, of which England took 17.8 per cent., the United States 16.1 per cent., and Germany 9.5 per cent. The local building boom, which had its origin in the remission of taxation for a long period, and is expected to continue for at least another year, has stimulated home sales of sheet glass, decorative glassware and glass for lighting purposes.

The industry is perturbed at the tendency in America to protect home production by means of a higher tariff, especially as glass and glassware represent the biggest item among exports from Czechoslovakia to that country. Czechoslovak manufacturers have requested their Government to consider counter measures by way of co-operating with other European countries—France, in particular—in the restriction of imports of American motor vehicles.

IMPERIAL CHEMICAL INDUSTRIES LIMITED.

The Directors of Imperial Chemical Industries, Limited, announce that the profit for the year 1928 amounts to £5,488,243, representing an increase on 1927 of £921,018. With the £82,680 brought forward from 1927, the total profit available is £5,570,923. Out of this sum the Directors have decided to transfer £1,000,000 to General Reserves, £275,540 to Income Tax Account and to carry forward to 1929 £109,633, leaving £4,185,750 available for distribution to the Shareholders. After providing £1,194,550 for the dividend on the Preference Shares, there remains £2,991,200 for the Ordinary and Deferred Shareholders. An interim dividend of three per cent. on the Ordinary Shares was paid on 1 December, 1928. The Directors have therefore decided to recommend a final dividend on the Ordinary Shares of five per cent. (actual), making eight per cent. for the year, and a dividend on the Deferred Shares of one and three quarters per cent. (actual) both less Income Tax at the standard rate for the year 1919-130, payable on 1 June, 1929, to the Shareholders on the register of members at 18 April, 1929. The registers of Ordinary and Deferred Shareholders will be closed from the 18 April, 1929, to the 2 May, 1929, both dates inclusive.

BREEZE & CLINKER AGGREGATES.

Investigations by the Department of Scientific and Industrial Research have been proceeding at their Building Research Station for some time into the causes of failure experienced with breeze and clinker concretes. The object is to evolve simple methods to enable their soundness to be tested, and a description of the proposed tests is given in building Research Bulletin No. 5. (H.M. Stationery Office, price 6d. net.)

The details of the experimental work and particulars of the results on which these tests are based will be of interest to special sections of the industry ,to research workers in the same field, and to other scientific investigators.

They have accordingly been published in Technical Paper No. 7. The investigations have been comprehensive in scope, and not only have the scientific aspects of the subject been fully considered, but care has been taken to examine all typical cases of the uses of breeze and clinker, for example, in poured concrete as well as in pre-cast blocks and partition slabs, and pressed bricks.

MINERAL RESOURCES OF SOUTH AFRICA.

A lecture on "The Base Metal and Mineral Resources of South Africa," was given by Mr. H. Warington Smyth, C.M.G., M.A., F.G.S., M.I.M.M., late Secretary for Mines and Industries of the Union of South Africa, at the Royal Society of Arts, John Street Adelphi, London, W.C.2., on Tuesday, 26 March. The chair was taken by Professor J. G. Lawn, C.B.E., A.R.S.M., Vice-President of the Institution of Mining and Metallurgy.

LARGE CRUDE OIL PRODUCER STRUCK IN TURNER VALLEY, ALBERTA, CANADA.

The coming into production of Royalite Well, No. 15, is a further important event in the rapid development now taking place in the Turner Valley oil field, Alberta. In contrast to the recent drilling into production of the Home No. 1 Well, at a depth of 5,280 feet in the limestone formation, the strike in Royalite No. 15 was made in the upper, or Kootenay, formation, at a depth of 3,030 feet, and the well is flowing about 300 barrels per day of crude oil under gas pressure.

ONTARIO GOVERNMENT LETS CONTRACT FOR EXPLORATION OF LIGNITE DEPOSITS.

Following the Ontario Government's decision to explore the extent and value of the lignite deposits along the Abitibi River in Ontario, the Hon. Charles McCrea, Minister of Mines for the Province, announces that a contract for this work has been awarded to Messrs. Smith and Travers, Ltd., diamond drilling operators at Sudbury, Ont.

Explorations will be centred around Blacksmith Rapids, approximately 100 miles north of Cochrane, and some 18 miles north of the present end of steel on the Timiskaming and Northern Ontario Railway, where the biggest lignite deposits are located.

LIEBIG'S EXTRACT OF MEAT CO. LTD.

A half-year's dividend, *viz.*, Two shillings and sixpence per share (being at the rate of 5 per cent. per annum) less income tax at 4s. in the £, will become payable on and after 2 April, 1929, to the proprietors of Preference shares who are registered on the Company's books on 14 March, 1929.

In respect of Coupon No. 57 of the Preference shares to Bearer such dividend, less income tax at 4s. in the £, will be payable on and after 2 April, 1929, at the Company's bankers: Messrs. Glyn, Mills & Co., 67, Lombard Street, London, E.C.3.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

Synopses of Papers Presented at the Twenty-First Annual Meeting.

(*Continued from Page* 188.)

The Constitution of the Cadmium-Rich Alloys of the System Cadmium-Gold. By P. J. Durrant, M.A., Ph.D., Member, Fellow of Selwyn College, Cambridge.

The constitution of the alloys of cadmium and gold from 0 to 48 atoms per cent. of gold has been reinvestigated by the methods of thermal and micrographic analysis.

Saldau's equilibrium diagram, published in 1915, has been modified in the following manner:

(1) The liquidus from the eutectic point at 7.95 atoms per cent. of gold and 309° C. rises not to a triple point at 25 atoms per cent. of gold and 495° C., but to a maximum at 28.6 atoms per cent. of gold and 500° C., and thereafter falls to a eutectic point at 30.0 atoms per cent. of gold at 496° C. The horizontal line drawn by Saldau at 495° C. is not, therefore, a peritectic but a eutectic horizontal. Between the compositions 30.0 and 48 atoms per cent. of gold the form of the liquidus is not a smooth curve, but is broken by a sharp discontinuity at 39.4 atoms per cent. of gold and 540° C., where a peritectic line meets the liquidus.

(2) A new area of solid solution has been detected (denoted as phase III in the paper) which lies in the field described by Saldau as containing $\beta+\gamma$. This solid solution has been closely studied and has been found to undergo two polymorphic changes —one at about 500° C., and the other at about 375° C. The change at 375° C. is interesting, as it is analogous to the change in the β phase of brass at 460° C.

(3) No evidence could be obtained for the existence of the compound $AuCd_3$ at the liquidus, but the form of the equilibrium diagram suggests the existence of two compounds, Au_2Cd_5 and Au_2Cd_3, both of which are much dissociated at high temperatures.

The Age-Hardening of Some Aluminium Alloys. By Marie L. V. Gayler, D.Sc., Member, Assistant, Dept. Metallurgy and Metallurgical Chemistry, National Physical Laboratory, and G. D. Preston, B.A., Assistant, Dept. Metallurgy and Metallurgical Chemistry, National Physical Laboratory.

The following physical properties of five typical aluminium alloys containing copper, magnesium silicide, or both, have been examined under similar conditions of heat-

treatment; (1) Brinell hardness; (2) tensile strength ;(3) density; (4) electrical conductivity; (5) changes in the crystals, as determined by X-ray analysis.

It is shown that the changes in density and in lattice parameter which take place during ageing suggest that precipitation from solid solution takes place. X-ray analysis shows also that the crystals themselves are in a disturbed state, which is gradually relieved by further ageing at high temperatures. The increase in electrical resistance on ageing corresponds to this distortion o fthe space lattice of the solid solution, caused by the presence of minute particles due to the decomposition of the solid solution.

It has been inferred that the precipitation from solid solution entails two processes—(1) the rejection of the atoms of the dissolved metal from the lattice of the solid solution, accompanies by the possible formation of molecules; (2) a "coagulation" of these rejected atoms or molecules takes place, a process which follows closely upon the first, and probably largely overlaps it.

The evidence given may be regarded as strong confirmation of the theory that hardening is due to the precipitation of highly dispersed particles.

Brittleness in Arsenical Copper.—II. By Clement Blazey, M.Sc., Member, Metallurgist, Metal Manufactures Pty., Ltd., Port Kembla, N.S.W., Australia.

In a paper previously presented to the Institute a description was given of a type of brittleness in arsenical copper characterised by low tensile strength and elongation, a non-necked, intercrystalline fracture, and inability to withstand repeated bending after annealing below 600°-650° C. After annealing at a higher temperature the brittleness disappeared, but it reappeared when the coppper was cold-worked and again annealed at a relatively low temperature. At the time the cause of the trouble could not be ascertained.

A series of melting and working tests has since been carried out. It has been found that, under certain conditions, a small amount of bismuth (about 0.004 per cent.) can produce a susceptibility to brittleness remarkably like that previously described.

The conditions are : plain melting under charcoal of arsenical copper of the quality used, followed by poling and the addition of bismuth before casting. The addition of phosphorus after bismuth destroys the susceptibility. The susceptibility may be removed by remelting. If phosphorus is added, several remeltings may be necessary. If the metal is in the form of fairly fine wire, then long heating in hydrogen at a high temperature removes the susceptibility. The brittleness has been encountered in non-arsenical copper.

A Note on the Haughton-Hanson Thermostat. A Method of Fine Adjustment. By P. J. Durrant, M.A., Ph.D., Member, Fellow of Selwyn College, Cambridge.

A modification of the "cold-bulb" of the Haughton-Hanson thermostat is described, by means of which the temperature of the thermostat can be adjusted over a range of 5° C., with an accuracy of 0.1° C .

The System Magnesium-Zinc. By W. Hume-Rothery, M.A., Ph.D., Member, Senior Demy, Magdalen College, Oxford, and E. O. Rounsefell, B.A., B.Sc., Member, Lincoln College, Oxford.

(1) The equilibrium diagram of the system magnesium-zinc has been investigated in the range 0 to 70 atomic per cent. magnesium, the magnesium-rich alloys having already been studied by Hanson. Particular attention has been paid to the structure of the solid alloys and the limits of solid solution in the various phases. Twentythree points on the liquidus have also been determined, but this part of the diagram is already well known.

(2) The solid solubility of magnesium in zinc increases from about 0.15 atomic per cent. magnesium at 200° C. to 0.3 atomic per cent. at 364° C., which is the temperature of the Zn-$MgZn_5$ eutectic.

(3) The temperature of the $MgZn_5$-Zn eutectic has been accurately determined by cooling curves and quenching experiments as 364° C. In ordinary cooling curves it is liable to considerable fluctuations, which are regarded as due to the suppression of the peritectic reaction by which the compound $MgZn_5$ should be formed at 381° C., but which in practice is delayed, so that it occurs at the same time as the eutectic separation.

(4) The compound $MgZn_5$ previously discovered by Chadwick has been confirmed, but the solid solution in this compound which was claimed by Chadwick has been shown not to exist. This part of the work has been carried out in great detail, and it is shown that after prolonged annealing an alloy containing 6.5 atomic per cent. magnesium shows traces of free zinc, whilst one of composition 16.8 atomic per cent. magnesium shows traces of $MgZn_2$. This corresponds to a difference of less than 0.1 per cent. magnesium by weight, and it is con-

cluded that this is evidence of a compound of fixed composition.

(5) The compound $MgZn_2$, discovered by Grube, has been confirmed, but the wide solid solution in this compound claimed by Chadwick has been shown not to exist. This discrepancy is due to the fact that the acid ferric chloride etching reagent used by Chadwick does not distinguish clearly between the compound $MgZn_2$ and a new compound MgZn, which is described for the first time.

(6) A new compound, MgZn, has been shown to exist, and this also is of fixed composition. It may be distinguished from $MgZn_2$ by means of Benedicks' reagent. The compound is formed at 354° C. by a peritectic reaction between $MgZn_2$ and liquid. The arrests corresponding to the formation of this componnd were observed by Chadwick, who regarded them as due to a transformation of the supposed solid solution in the compound $MgZn_2$, but the present work shows conclusively that they are due to the formation of MgZn.

(7) These data together with those of Hansen enable the complete diagram to be drawn.

(8) On the practical side the present work shows that in Elektron metal, and similar alloys, any zinc present in excess in the form of the new compound MgZn, and not, as previously supposed, as $MgZn_2$.

(9) The relations between the magnesium-zinc and magnesium-cadmium diagrams are discussed. Both contain analogous rather unstable compounds, $MgZn_2$ and $MgCd_2$, but whilst the Mg-Cd system contains wide solid solutions in the parent metals, the Mg-Zn system shows little solid solubility in the two metals, but forms two very unstable compounds, $MgZn_5$ and MgZn. Evidence is given indicating that these may exist in the solid state only, and not as definite molecules in the liquid. It is shown that concurrently with these facts the atomic volumes of magnesium and cadmium are nearly equal, but differ widely from that of zinc. It is suggested that where two metals form one principal but rather unstable compound, the atomic volumes are one of the chief factors in determining whether wide solid solutions are formed in the parent metals or not.

(To be continued.)

SOCIETY OF GLASS TECHNOLOGY.

The 114th meeting of the Society of Glass Technology was held in Sheffield on Wednesday, February 20, the President, W. Butterworth, Senr., M.A., in the chair. The following three papers were presented (a fourth paper was taken as read, namely, "The Design of Glass Polishing Machines, Part II." By Dr. F. W. Preston.)

Heat Resisting Steels with Special Reference to their Application in the Glass Industry. By R. J. SARJANT, M.Sc.

The paper described the properties of heat-resisting steels, and gave some brief review of the recent developments in their industrial applications. The materials described were the outcome of extensive researches on the part of Sir Robert Hadfield, and the Research Staff of his Company in Sheffield, and their French associates of the Imphy Steel Works, including a distinguished group of names, Chevenurd, Dumas, Guillaume, Payol, Girin and Mugnet.

Heat resisting steels were materials which combined resistance to heat both as regards scaling and strength with tenacity, ductility, malleability and machinability. Strength and malleability at high temperatures had been combined in an achievement of far-reaching utility. Progress in the development of practical forms had resulted in the production of machined castings and forgings, sheet, rolled sections, wire and even hot rolled tubes.

The alloys described had in general a homogeneous structure, an absence of the normal critical change points, and remained permanent in their physical character in service They found their best usefulness in the range of temperature 600-1100° C. There were alloys of a somewhat more brittle nature which are capable of resisting oxidation up to 1200° C. The composition of the alloys described covered two separate ranges; 10-25 per cent. chromium with 7-10 per cent. of nickel and iron 65175 per cent.; 10-15 per cent. chromium with 30 to 40 per cent. nickel and iron 50-60 per cent. In all cases silicon, tungsten, molybdenum, etc., may be added according to requirements.

The scale resistance in a test in an oil-fired furnace at 950° C. was of the order 80 millionths to 4.4 thousandths of an inch loss due to scaling after 2,500 hours. There was a superior resistence to the action of sulphurous gases, as well as some superiority of resistance to scaling, and of strength at the highest practicable temperature in comparison with alloys of the two containing high percentages of nickel.

As regards strength at high temperatures, the limiting creep strength, which provides the useful criterion for the designer was for a typical Era H.R. alloy. The alloys welded readily to themselves and other steels by means of the oxy-acetylene or arc-welding processes.

The normal mechanical properties were of a high grade. The linear expansion was 12.5-19 millionths of an inch per 1° C., between 20° and 950° C. The electrical resistivity was of such an order as to enable the material to be used for heater elements

The special applications to the Glass Industry included recuperator tubes, glass moulds, blowing irons, feeder nozzles and conveyor chains for annealing lehrs. Recuperators made of heat resisting steel had been used extensively. They were robust, did not leak, occupied small space, and permitted the use of high gas velocities and a high rate of heat transmission. Coefficients as high as 25.8 B.Th.U. per hour per square foot per 1° F. had been obtained and air had been preheated to 950° C. Up to 1,000° C. working temperature the tubes had a life measured in years, and a considerable life was obtained at temperatures as high as 1,100° C.

The possibilities of the metallic regenerator were indicated, the thermal advantage of the metal chequer being 18 times that of, say, firebrick, but the main utility of heat resisting alloys would be for the moving regenerator.

A case was described of the application of special steel to glass moulds which enabled the output of bottles to be raised from 50,000 to 2,000,000 without replacement.

An intermediate type of material, being a Silchrome steel, containing 8-9 per cent. of chromium and 3 to 3½ per cent. of Silicon, had a range of uses in the Glass industry, where conditions were not so severe as to demand the higher grade of materials.

Production was now dealt with in comparatively large tonnages, up to 3 tons in the case of single castings. The higher initial cost must be judged in the light of superior performance and consequent saving from length of service, and particular regard was to be paid to the unforeseen field of development in which the best progress always lay.

Note on the Homogeneity of Small Scale Meltings in Platinum. By VIOLET DIMBLEBY, M.Sc., H. W. HOWES, M.Sc., Tech., AND PROF. W. E. S. TURNER.

The observations concerned soda-lime-silica glasses melted in platinum. Although melted under carefully controlled conditions, lengths of rod drawn from a single melting were found to vary in composition along their length.

Several series of experiments confirmed this result, and it was only after three remeltings, with intermediate crushing of the glass, which was then returned to the crucible, that homogeneity was obtained throughout the mass.

This conclusion was of great importance in view of the great amount of research work being done at the present time on the physical properties of glass.

An Observation on Professor Le Chatelier's Equation for the Viscosity of Glass. By DR. F. W. PRESTON.

The equation referred to was the one devised by Professor H. Le Chatelier to express the variation of viscosity of glass with temperature.

It was the purpose of the note to point out that the fact that the formula produced a straight line when graphed was a mere mathematical accident, and was in great measure independent of any experimental results; that it depended mainly on the fact that the French (C.G.S.) unit of viscosity was a very small unit; that in English (Engineering) units, or even in French Engineering units, Le Chatelier's equation gave imaginary results at most temperatures; and that, in its present form at least, the equation was mathematically inadmisible and physically meaningless.

Prof. Le Chatelier in reply observed that, however unsatisfactory in theory the double logarithmic formula might be, it yet presented two practical advantages which he had pointed out and on which he wished to insist :

1. It was greatly to the interest of every experimenter to represent the results of his experiments graphically by means of straight lines so that he could see at once the figures which were discrepant and thus correct them. A curve drawn by hand could not render the same service, because one instinctively tried to make it pass through all the points good and bad.

2. It is certain that the viscosity of glasses depended directly on their chemical composition, and yet investigators of this property did not succeed in recognising the existence of this relation. The double logarithmic formula enabled this to be done very easily.

THE OPTICAL SOCIETY.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Optical Society was held on Thursday, 13 March, 1929.

The reports of the Council and Hon. Treasurer and the audited accounts for the year 1928 were presented and adopted.

Votes of thanks to the Governors of the Imperial College of Science and Technology, and Professor Callender for granting facilities to the Society for holding their meetings at the Imperial College of Science and Technology, to the retiring Council and the Hon. Auditors, were carried unanimously.

The Officers and Members of Council for the Session 1929-30 were elected as follows: *President*—F. Twyman, F.R.S. *Vice-Presidents* — D. Baxandall, F.R.A.S., A.R.C.S.; J. Guild, A.R.C.S., F.R.A.S., F.Inst.P.; Prof. A. F. C. Pollard, A.R.C.S., A.M.I.E.E., F.Inst.P.; F. C. Watts. *Hon. Treasurer*—Major E. O. Henrici, R.E. (ret.) F.R.A.S., F.Inst.P. *Hon. Secretaries*—W. B. Coutts, M.A., B.Sc., F.R.S.E., F.R.A.S., Military College of Science, Woolwich, S.E.18; A. Whitwell, M.A., 82, Marryat Road, Wimbledon, London, S.W.

At the Ordinary Meeting the following papers were read and discussed:—

A Re-Determination of the Trichromatic Coefficients of the Spectral Colours. By W. D. WRIGHT, A.R.C.S., D.I.C., B.Sc.

Using a new trichromatic colorimeter a series of colour matches through the spectrum has been made by ten observers. The results have been averaged and a mean set of trichromatic coefficients for the spectral colours derived. These results are compared with previous determinations made by Konig and Abney. The variations in the coefficients that have been found amongst the ten observers must, as a consequence of a new method of basing the trichromatic units, be attributed to variations in the process of reception, but their magnitude appears to be of a small order. On the other hand, there are big differences in the amount of the macular pigment in different eyes and probably some variations in its dominant hue. These variations have been investigated by matches on a standard white, results for 36 observers being given in the paper and a mean value determined. This value, combined with the mean spectral coefficients ,has been used to compute an average locus for the spectral colours in the colour triangle with white at the centre.

Other points discussed in the paper include the technique of colour matching, the range of intensity over which matches remained valid, and variations of luminosity.

On the Testing of a Novel Photographic Shutter. By JOHN S. ANDERSON, M.A., D.Sc., F.Inst.P.

The paper describes the methods which were adopted at the National Physical Laboratory for measuring the durations of exposure and the efficiencies of a "Louvre" photographic shutter, which was recently submitted for test.

Interesting discussions followed both papers, and votes of thanks to the authors were moved from the chair, and carried with acclamation.

GEOLOGICAL SOCIETY OF LONDON.

March 6.

MRS. M. M. OGILVIE GORDON, D.Sc., F.G.S., delivered a lecture on *The Structure of the Western Dolomites*, illustrated by lantern-slides and maps.

She described briefly the stratigraphical succession of the Permian and Triassic rocks which mainly compose the mountain-lands of the Western Dolomites, and showed their character in a number of photographic slides. Special attention was given to the outbreaks of volcanic action which took place in the Upper Buchenstein and Wengen periods at the close of the Alpine Middle Trias. These were associated with long crust-fissures in a west-north-westerly and east-south-easterly direction, in the course of which numerous vents occurred. Sills and dykes of andesite were much more frequent than had been supposed, although the sills were near the surface, and differed little from the lava-flows. Crust-movements took place, and certain areas were relatively uplifted as submarine terraces while inthrows occurred along the volcanic zones. Discordances and alternations were shown between the lavas and tuffs of the volcanic zones and the Marmolata Limestone or Schlern Dolomite that formed on the terraces.

The Dachstein Dolomite, which succeeds the Raibl strata, forms a massive deposit throughout the Enneberg and Ampezzo district, but has been mostly eroded from the western area.

The leading structural features were described, with the aid of the geological map of the Gröden and Fassa district published by the lecturer in 1927. Several phases of mountain-movement could be distinguished in this district. During the regional movements of uplift of the Eastern Alps the whole district had been thrown into anticlines and

synclines extending almost due east and west (N. 80°-85° W.). These were cut by numerous east-to-west vertical faults. Later, during periods of intensified crust-pressures, the faults were in many places overcast northwards or southwards, or in some oblique direction. The older fold-forms were locally thrown into steep knee-flexures, or new flexures developed, and new faults cut through them, usually, with an inclination *in one direction or another and the occurrence of local overthrusts.*

Transverse vertical faults occurred at fairly regular intervals throughout the district, and at an advanced period, associated by the lecturer with the Dinaric (Peri-Adriatic) movements, cross-plication and cross-thrusting had been set up. The major fold-gorms were of the nature of wide asymmetric anticlines with a steep western wing and a long gently-inclined eastern wing. The chief complications of the cross-movements occurred on the west side of these anticlines and in the areas of adjacent subsidence.

A number of photographs of leading thrust-planes in the district and geological sections illustrated the relations of the thrust-masses of Pitschberg, on the north of Gröden Valley, Langkofl and Plattkofl, on the south of that Valley, and Buffaure, on the east of Fassa Valley. The horizontal *displacements* had not exceeded 2½ kilometres.

Still farther east, the lecturer showed in her geological map of Enneberg the occurence of another zone of east-to-west thrusts on the east of the Lower Enneberg and St. Vigil area, a zone associated with overthrusts in the extensive tract of dolomite-rock between Enneberg and Ampezzo.

March 20.

Some South Australian Algal Limestones in Process of Formation. By Sir Douglas Mawson, O.B.E., D.Sc., B.E., F.R.S., F.G.S.

The Unroofing of the Dartmoor Granite, and an Outline of the Distribution of its Detritus in the Sediments of Southern England. By Arthur W. Groves, Ph.D., M.Sc., D.I.C. (Communicated by Prof. W. W. Watts, Sc.D., F.R.S., F.G.S.

Fossil algæ from a pre-Cambrian or early Cambrian horizon in the McDonnell Ranges, Central Australia, were exhibited by Sir Douglas Mawson, O.B.E., D.Sc., B.E., F.R.S., F.G.S.

NOTICES OF BOOKS.

Year Book of The Czechoslovak Republic, 1929. Edited by Bohuslav Horak. Pp. 316, with map, and illustrated. Prague: "Orbis," Fochova 62. 1929. Price 7s. 6d.

Czechoslovakia, within ten years of its existence has made rapid progress. Its industrial and economic position has been stabilised and, with this, attention has been turned towards science and the scientific development of the country's extensive resources.

Prof. Horák, of the Masaryk University of Brno, has edited the invaluable Year Book for 1929 in which is given a mass of information and statistics concerning Czechoslovakia, which has taken over about 57 per cent. of the industries of the former Austro-Hungarian Empire. These were *originally destined to supply a "home" market and in 1918 these industries were faced with the problem of adapting themselves to an export trade in markets of greatly diminished purchasing power and* high tariffs. The leaders of the country and its industrialists can be congratulated upon establishing a flourishing trade and having a negligible number of unemployed. It is interesting also to note that purchase of goods from England considerably exceed the value of those exported to England.

Of the characteristic industries where science, especially chemistry, plays a part mention may be made of the very large breweries at Pilsen and Budejovice and the cultivation of beet and the extraction and refining of sugar which is carried on all over the country. The iron and steel works in various areas are more extensive than is generally realised in England. The Skoda Works at Pilsen occupy an area of many square miles and the Vitkovice works at Ostrava (Silesia) recently celebrated their centenary.

Of recent years there has been a marked increase in the manufacture and export of leather goods. Bohemian glass and pottery are well-known. Czechoslovakia also possesses radium and uranium mines at Jáchymov, N.W. Bohemia. It is well endowed with curative and thermal spas, most of whose mineral waters are usually relatively strongly radioactive and also hot. The chief spas are Karlovy Vary (Carlsbad), Marianske Lázne (Marienbad), Piest'any, Trencianské Teplice and Podebrady. Waters from some of these are bottled and exported.

Prof. Horák's remarks concerning the periodicals and press of Czechoslovakia are interesting. The publishers of the *Year Book* also issue a daily (in German) *Prager Presse*, and several weeklies, including one in English, *The Central European Observer*,

which presents a survey of the events, industrial and economic developments, and the literature of Middle Europe generally.

The Year Book of the Czechoslovak Republic can be recommended to all seeking information concerning Central Europe.

J. G. F. DRUCE.

A Concise Summary of Elementary Organic Chemistry. By FREDERICK HURN CONSTABLE, M.A., D.Sc., etc. Pp. xii + 150. London: Methuen & Co., Ltd., 36, Essex Street, W.C.2. Price 4s. 6d.

The title of this work is appropriate as being accurately descriptive of its contents. As a compact summary it will prove helpful to students preparing for examinations or to any chemist desiring to "brush up" his knowledge of chemistry, leaving the ground open for conference with more exhaustive works on any branch of organic chemistry. Obviously the work is the result of observations and practical experience and is certain to prove useful to those for whom it has been written.

Forthcoming Events.

DEVELOPMENTS OF BRITISH CHEMICAL MANUFACTURERS.

A public meeting on the above subject will be held in the Mansion House, London, E.C.2., on Wednesday, 24 April, 1929, at 4.30 p.m., when the Rt. Hon. Lord Melchett, P.C., D.Sc., F.R.S. (President of the British Science Guild) will take the chair.

The programme will include the following addresses :—

"Fertilisers from the Air," by Sir Frederick Keeble, C.B.E., Sc.D., F.R.S. (of Imperial Chemical Industries, Ltd.).

"Rayon (Artificial Silk)," by A. B. Shearer, Esq., F.T.I. (of Messrs. Courtaulds, Ltd.).

"Synthetic Drugs," by Francis H. Carr, Esq., C.B.E. (of the British Drug Houses, Ltd.).

Tickets for the meeting may be obtained on application to the British Science Guild, 6, John Street, Adelphi, W.C.2.

SOCIETY OF PUBLIC ANALYSTS.

The next meeting of the Society will be held on Wednesday, April 3, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1., at 8 p.m. The following papers will be read :—

"Furfural Diastase in Heated Honey." By L. H. Lampitt, D.Sc., F.I.C., E. B. Hughes, M.Sc., F.I.C., and H. S. Rooke, M.Sc., A.I.C.

"Further Notes on Methods of Sewage and Water Analysis; Anti-Oxidation, and Stabilisation of Pollution." By J. W. Haigh Johnson, M.Sc., F.I.C.

"Potassium Cyanate as a Reagent for the Detection of Cobalt." By B. J. F. Dorrington, B.Sc., A.I.C., and A. M. Ward, B.Sc., Ph.D., A.I.C.

ROYAL SOCIETY OF ARTS.

Wednesday, April 10, at 8 p.m. — (Ordinary Meeting) G. H. Nash, C.B.E., European Chief Engineer, International Standard Electric Corporation: "A Brief Review of Speech Communication by Electric Methods."

Friday, April 12, at 4.3 0p.m.—(Indian Meeting). A. T. Cooper, M.Inst.C.E., M.Cons.E.: "Recent Electrical Developments in India."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

7,404.—Bentley, W. H., & Coates, W. M., & Riley & Sons, Ltd.—Purification of sulphuric acid. March 7th.

7,485.—Consortium fur Elektrochemische Industrie Ges.—Process for obtaining concentrated acetic acid. March 7th.

7,687.—Hayes, D. — Concentration of acetic acid, etc. March 8.

7,781.—Hercules Powder Co. — Nitric acid. March 9.

6,998.—Neumann, E.—Manufacture of industrial alcohol. March 4.

Specifications Published.

296,974.—Soc. Anon. des Distilleries des Deux-Sevres.—Continuous process for the manufacture of acetic acid in the anhydrous state from its aqueous solutions.

301,415.—Soc. Anon. des Distilleries des Deux-Sevres.—Continuous process for the manufacture of acetic acid in

the anhydrous state from its aqueous solutions.

Abstract Published.

303,808.—Ferric oxide; sulphuric acid.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

The dehydration and decomposition of iron sulphates is effected in the presence of a decomposition product of an iron salt, preferably ferric oxide. A small amount of an alkali or alkaline earth oxide ,hydroxide, or carbonate may also be present. Oxidation may precede or be effected simultaneously with the drying and decomposition, and a catalyst for the gaseous decomposition products, for instance ferric oxide when added, may be present to obtain complete recovery of sulphuric acid as sulphur trioxide. In examples *10-30 per cent. of ferric oxide* is added, drying is effected at 300-400° C. in a revolving furnace and decomposition at 750-850° C. in a calcining furnace.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BURGOYNE'S

485,794.—Chemical substances used for veterinary purposes. — Burgoyne, Burbridge & Co., Ltd., High Street South, East Ham, London, E.6. March 13.

DIGUTIN.

497,082.—Chemical substances prepared for use in medicine and pharmacy. —The Wellcome Foundation, Ltd., 67, Holborn Viaduct, London, E.C.1. March 13.

CRUSHETTES.

498,692.—Chemical substances prepared for use in medicine and pharmacy.— Potter & Clarke, Ltd., 60, 62 and 64, Artillery Lane, London, E.1. March 13.

THYMOPHYSIN.

498,189.—Chemical substances prepared for use in medicine and pharmacy.— Chemosanunion und Fritz Pezoldt Aktiengesellschaft, Kolbegasse 10, Vienna, Austria. March 13.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne, ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3599.

MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

The Reduction of Naphthol Yellow by Means of Stannous Chloride 209
By J. G. F. Druce, M.Sc.
Studies on Crystallisation of Paraffin 210
By Y. Tanaka, R. Kobayashi, and S. Ohno.
Prospecting and the Discovery of Mines in South Africa 210
By Tudor G. Trevor.
Fire Resistance of Hollow Load-Bearing Wall Tile 211
By S. H. Ingberg & H. D. Foster.
Canada's Mining Industry in 1928 ... 212
Determination of CrO_4 in Paints 214
By Edward J. Davis, Ch.E.
General Notes 215
History of the Development of Fast Dyeing and Dyes 215
By James Morton.
Proceedings & Notices of Societies :—
The Institute of Metals 219
The Chemical Society 220
Mineralogical Society 221
Chemical Society of Japan 222

GENERAL INDEX TO THE
" CHEMICAL NEWS "—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net: Carriage paid to Foreign Countries and the Colonies, 23/- net.

THE REDUCTION OF NAPHTHOL YELLOW BY MEANS OF STANNOUS CHLORIDE.

By J. G. F. DRUCE, M.Sc.(Lond.), R.Nat.Dr.(Prague), F.I.C.

There appeared in the *Chemical News* a few years ago a number of communications from me giving an account of the preparation and properties of the organic stanno- and stannilchlorides, namely,

The Preparation of Aniline Stannichloride, *The Chemical News*, 1918, CXVII, 346.

The Preparation of Organic Stanno- and Stanni-chlorides.

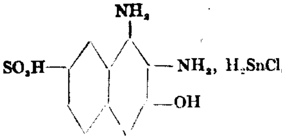
Part I. Salts of the Aliphatic Amines, *ibid*, 1919, CXVIII, 1;
Part II. Salts of the Aromatic Amines, *ibid.*, p. 87.
Part III. Compounds of the Amino-Acids, *ibid.*, CXIX, 73;
Part IV. Some Diamine Stannichlorides, *ibid.*, 1922, CXXIV, 310;
Part V. The Salts of Certain Special Bases, *ibid.*, CXXV, 265;
Part VI. The Action of Sulphuric Acid on Certain Stannichlorides, *ibid.*, 1924, CXXVIII, 33; and
Part VII. Some Miscellaneous Compouuds, *ibid.*, 1925, CXXX, 385.

The compound described in the present communication should be included among those given in the last reference above.

The stannichloride of the amino-compound corresponding with naphthol yellow has been obtained by the reduction of that nitro-compound with stannous chloride.

Five grams of naphthol yellow were gradually added to a hot solution of 5 gr. of stannous chloride dissolved in 50 c.c. of concentrated hydrochloric acid diluted with an equal volume of water. An almost colourless solution was produced, which deposited colourless crystals (m.p. about 112° C.) on cooling.

The new stannichloride



dissolved in water and was also slightly soluble in hot alcohol, but was insoluble in ether and carbon tetrachloride.

On analysis it was found to contain Sn, 20.8 and Cl, 86.8 per cent. $C_{10}H_{12}O_4N_2SCl_6Sn$ requires Sn, 20.2 and Cl 86.3 per cent.

STUDIES ON CRYSTALLISATION OF PARAFFIN. I. CRYSTAL FORMS OF PARAFFIN FROM SHALE OIL.

By Yoshio Tanaka, Ryonosuke Kobayashi, and Sadayuki Ohno.

When Fushun shale oil is distilled under ordinary pressure, and paraffin distillate (a fraction above 300° C) is cooled slowly, solid paraffin crystallises usually in scaly or plate forms, while petroleum paraffin crystallises in well formed needles from the paraffin distillate. The present paper deals with the studies on the crystal forms of shale oil paraffin and conditions related to the crystal forms.

The crude shale oil, from which the paraffin used in this investigation was obtained, was produced in Fushun Colliery, Manchuria, by retorting oil shale using an internal heating retort designed by the Colliery.

The crude paraffin was repeatedly washed with alcohol-ether (1 : 1) to remove oily parts.

The purified paraffin was separated into many fractions consisting of a few constituents respectively, by a method of successively collecting the melted parts by gradually raising the temperature, *viz.*, "fractional sweating." Each fraction thus obtained was used with success to obtain well defined crystal forms for the determination of the physical properties.

The results are summarised as follows :—

1. The major constituents of the shale paraffin melt at the temperature from 57-64° C and consist of normal paraffin hydrocarbons.

2. The crystals obtained from alcoholic solution of the paraffin were examined. The interlaced needles are generally produced at high concentration and high cooling velocity, whereas the plate crystals are obtained at lower concentration and lower cooling velocity. The plate formation of paraffin crystals are considered as the result of most stable arrangement of paraffin molecules.

3. The viscosity of the medium, in which paraffin is dissolved, acts an important *rôle* on the crystal forms of paraffin. The low viscosity of medium favours to the formation of plate crystals and the high viscosity to the needle crystals. The viscosity of paraffin distillate obtained from Fushun shale oil is extremely low. Hence the resulting paraffin crystals are naturally scaly.

4. The mutual transformation of two types of paraffin crystals may readily be made by controlling the viscosity of paraffin distillate.

5. Various forms of shale paraffin crystallised from alcoholic solution have been examined. The simplest form which is obtained at the highest dilution and the lowest cooling velocity of the solution, is a perfect rhombic plate which has the angles of 110° and 70°. The more complicated plate and needle forms may be considered to be formed by parallel growths of the rhomb, in the direction of the angle 110° in case of plate forms and in the direction of the angle 70° in the needle forms.

PROSPECTING AND THE DISCOVERY OF MINES IN SOUTH AFRICA.

By Tudor G. Trevor.

(Abstracted from *The Bulletin of the Institute of Mining and Metallurgy*, No. 294.)

Mr. F. Lynwood Garrison : Major Trevor's experience in South Africa in regard to the low ratio of valuable mineral discoveries to the total number of locations recorded, is much the same as ours has been in the United States and Canada. Prospecting in the semi-arid districts of our Western States is relatively easy, whereas in Eastern Canada and the extreme north-western, forested sections of both the United States and Canada, as well as in Alaska, it is difficult and arduous. Ontario and Quebec, on the whole, seem to me to be especially difficult in this respect. The first and most important discoveries at Cobalt and Porcupine were entirely fortuitous, but they gave the keynote, the experience, and the financial support for subsequent deliberate prospecting which has yielded some substantial results along with a large number of disappointments.

In the United States, and probably to some extent also in Canada, the old prospector is disappearing, his place being taken by the young graduates of our mining schools under the direction of older and more experienced mining engineers and geologists. The new science or art of geophysical prospecting is the outgrowth of this modern condition. There can be no doubt regarding the practical value and utility of such scientific geophysical investigations—it has been demonstrated many times—but we must not expect too much from it, for obviously it has limitations which are probably circumscribed.

It seems to me that Major Trevor's use of the term "fossicking" is unfortunate. It is, I believe, an Australian expression meaning "to work out the pillars of abandoned claims or waste heaps with the hope of find-

ing gold or rich ore." The Century Dictionary defines it as "gold mining under another's digging." In other words a fossicker is a gleaner. I do not believe any self-respecting prospector will stand for such an appellation, and he surely does not deserve it. We owe a great deal to these hardy long-suffering men who have done so much and played such an important and picturesque part in the development of our nascent mineral wealth. The word or name prospector is perfectly good English which anyone can understand, and it ought not be displaced, even in South Africa, by a term which, if not a misnomer, has nothing to recommend it. The use of the word "departure" seems to me also objectionable. As here applied it is a synonym for something unique, a condition rather more than out of the ordinary. No two mineral deposits are exactly alike any more than are any two men, but they possess general resemblances which serve to classify them, and the study of economic geology has taught us there are certain dules and principles based on chemical, physical, and structural conditions which are of world-wide application. Thus, for example, we find chromite, the platinoids, asbestos, and magnesite in basic rocks, tin in granite, and the oxide ores of manganese and iron in relatively superficial bedded deposits of sedimentary or metamorphosed sedimentary rocks. Other examples might be cited; it seems doubtful if South Africa has to offer many, if any, extraordinary exceptions or "departures" from the well-established principles of mineral deposition.

The amount of money and effort expended in prospecting has always been very large as compared with the value of the minerals subsequently won. In fact, in the State of Nevada, an area nearly twice as large as England and Wales, with a population of only about 75,000 or less, it has been stated that more has thus been expended than the total value of all the ores so far mined, and he it remembered this great area is semi-arid and very easy to prospect. Every mineralised district in this State is covered with mining claims and prospect holes of which perhaps not over 1 per cent. have so far proved of value. The perfectly natural gambling instinct which most men possess is no doubt responsible for this great waste of money and effort, but so long as strong men follow this impulse and the primitive, elemental call of the wild, prospecting will continue wherever there are indications of valuable minerals.

It is certain, however, that we must in the future give more attention to and depend upon the steadily improving science of economic geology, wherein are applied chemistry, physics, and rock structure, to an intensified study of mineral indications in specific locations. It is perhaps to the old geologists of the Freiberg school we owe the beginnings of this branch of geology and mining. Shrewd and often accurate observations, as well as classifications of ore deposits, were made in Germany as far back as Agricola's time, but is was not until about the middle of the nineteenth century, and later, that such men as Von Cotta, Groddeck, Stelzner, Posepny in Germany, and J. D. Whitney, then, later, in our own time, Raymond and Lingren, demonstrated the practical value of this special branch of geology.

FIRE RESISTANCE OF HOLLOW LOAD-BEARING WALL TILE.

By S. H. Ingberg and H. D. Foster.
(*U.S. Bureau of Standards.*)

The work reported in this paper consists in the main of three series of fire tests of wall constructions built of hollow load-bearing wall tile of representative designs and clay materials.

The first tests were made on wall sections 1 foot wide and 6 feet high that were subjected to fire on one side while under working load, the main object of the tests being to determine how the fire exposure affects the individual tile units. This was found to vary with the type of clay used, hardness of burning and design of the unit, from minor cracking of a few of the units in the specimen to failure under load a little after two hours.

The second group of tests was with wall specimens 4 feet wide and 4 feet high tested exposed to fire on one side, under load or restrained within the containing frames, and were made to study the effect of changes in design of the unit, and in the constituents and preparation of the clay.

Addition of up to 2 per cent. of ground burned clay (grog) to the raw clay was found to be without effect, but higher percentages increased the fire damage, apparently because of initial shrinkage cracks radiating from the raw clay decreased the tendency to cracking when exposed to fire without seriously decreasing the normal

STUDIES ON CRYSTALLISATION OF PARAFFIN. I. CRYSTAL FORMS OF PARAFFIN FROM SHALE OIL.

By YOSHIO TANAKA, RYONOSUKE KOBAYASHI, AND SADAYUKI OHNO.

When Fushun shale oil is distilled under ordinary pressure, and paraffin distillate (a fraction above 300° C) is cooled slowly, solid paraffin crystallises usually in scaly or plate forms, while petroleum paraffin crystallises in well formed needles from the paraffin distillate. The present paper deals with the studies on the crystal forms of shale oil paraffin and conditions related to the crystal forms.

The crude shale oil, from which the paraffin used in this investigation was obtained, was produced in Fushun Colliery, Manchuria, by retorting oil shale using an internal heating retort designed by the Colliery.

The crude paraffin was repeatedly washed with alcohol-ether (1 : 1) to remove oily parts.

The purified paraffin was separated into many fractions consisting of a few constituents respectively, by a method of successively collecting the melted parts by gradually raising the temperature, *viz.*, "fractional sweating." Each fraction thus obtained was used with success to obtain well defined crystal forms for the determination of the physical properties.

The results are summarised as follows :—

1. The major constituents of the shale paraffin melt at the temperature from 57-64° C and consist of normal paraffin hydrocarbons.

2. The crystals obtained from alcoholic solution of the paraffin were examined. The interlaced needles are generally produced at high concentration and high cooling velocity, whereas the plate crystals are obtained at lower concentration and lower cooling velocity. The plate formation of paraffin crystals are considered as the result of most stable arrangement of paraffin molecules.

3. The viscosity of the medium, in which paraffin is dissolved, acts an important *rôle* on the crystal forms of paraffin. The low viscosity of medium favours to the formation of plate crystals and the high viscosity to the needle crystals. The viscosity of paraffin distillate obtained from Fushun shale oil is extremely low. Hence the resulting paraffin crystals are naturally scaly.

4. The mutual transformation of two types of paraffin crystals may readily be made by controlling the viscosity of paraffin distillate.

5. Various forms of shale paraffin crystallised from alcoholic solution have been examined. The simplest form which is obtained at the highest dilution and the lowest cooling velocity of the solution, is a perfect rhombic plate which has the angles of 110° and 70°. The more complicated plate and needle forms may be considered to be formed by parallel growths of the rhomb, in the direction of the angle 110° in case of plate forms and in the direction of the angle 70° in the needle forms.

PROSPECTING AND THE DISCOVERY OF MINES IN SOUTH AFRICA.

By TUDOR G. TREVOR.

(Abstracted from *The Bulletin of the Institute of Mining and Metallurgy*, No. 294.)

Mr. F. Lynwood Garrison : Major Trevor's experience in South Africa in regard to the low ratio of valuable mineral discoveries to the total number of locations recorded, is much the same as ours has been in the United States and Canada. Prospecting in the semi-arid districts of our Western States is relatively easy, whereas in Eastern Canada and the extreme north-western, forested sections of both the United States and Canada, as well as in Alaska, it is difficult and arduous. Ontario and Quebec, on the whole, seem to me to be especially difficult in this respect. The first and most important discoveries at Cobalt and Porcupine were entirely fortuitous, but they gave the keynote, the experience, and the financial support for subsequent deliberate prospecting which has yielded some substantial results along with a large number of disappointments.

In the United States, and probably to some extent also in Canada, the old prospector is disappearing, his place being taken by the young graduates of our mining schools under the direction of older and more experienced mining engineers and geologists. The new science or art of geophysical prospecting is the outgrowth of this modern condition. There can be no doubt regarding the practical value and utility of such scientific geophysical investigations—it has been demonstrated many times—but we must not expect too much from it, for obviously it has limitations which are probably circumscribed.

It seems to me that Major Trevor's use of the term "fossicking" is unfortunate. It is, I believe, an Australian expression meaning "to work out the pillars of abandoned claims or waste heaps with the hope of find-

ing gold or rich ore." The Century Dictionary defines it as "gold mining under another's digging." In other words a fossicker is a gleaner. I do not believe any self-respecting prospector will stand for such an appellation, and he surely does not deserve it. We owe a great deal to these hardy long-suffering men who have done so much and played such an important and picturesque part in the development of our nascent mineral wealth. The word or name prospector is perfectly good English which anyone can understand, and it ought not be displaced, even in South Africa, by a term which, if not a misnomer, has nothing to recommend it. The use of the word "departure" seems to me also objectionable. As here applied it is a synonym for something unique, a condition rather more than out of the ordinary. No two mineral deposits are exactly alike any more than are any two men, but they possess general resemblances which serve to classify them, and the study of economic geology has taught us there are certain dules and principles based on chemical, physical, and structural conditions which are of world-wide application. Thus, for example, we find chromite, the platinoids, asbestos, and magnesite in basic rocks, tin in granite, and the oxide ores of manganese and iron in relatively superficial bedded deposits of sedimentary or metamorphosed sedimentary rocks. Other examples might be cited; it seems doubtful if South Africa has to offer many, if any, extraordinary exceptions or "departures" from the well-established principles of mineral deposition.

The amount of money and effort expended in prospecting has always been very large as compared with the value of the minerals subsequently won. In fact, in the State of Nevada, an area nearly twice as large as England and Wales, with a population of only about 75,000 or less, it has been stated that more has thus been expended than the total value of all the ores so far mined, and be it remembered this great area is semi-arid and very easy to prospect. Every mineralised district in this State is covered with mining claims and prospect holes of which perhaps not over 1 per cent. have so far proved of value. The perfectly natural gambling instinct which most men possess is no doubt responsible for this great waste of money and effort, but so long as strong men follow this impulse and the primitive, elemental call of the wild, prospecting will continue wherever there are indications of valuable minerals.

It is certain, however, that we must in the future give more attention to and depend upon the steadily improving science of economic geology, wherein are applied chemistry, physics, and rock structure, to an intensified study of mineral indications in specific locations. It is perhaps to the old geologists of the Freiberg school we owe the beginnings of this branch of geology and mining. Shrewd and often accurate observations, as well as classifications of ore deposits, were made in Germany as far back as Agricola's time, but is was not until about the middle of the nineteenth century, and later, that such men as Von Cotta, Groddeck, Stelzner, Posepny in Germany, and J. D. Whitney, then, later, in our own time, Raymond and Lingren, demonstrated the practical value of this special branch of geology.

FIRE RESISTANCE OF HOLLOW LOAD-BEARING WALL TILE.

By S. H. Ingberg and H. D. Foster.
(*U.S. Bureau of Standards.*)

The work reported in this paper consists in the main of three series of fire tests of wall constructions built of hollow load-bearing wall tile of representative designs and clay materials.

The first tests were made on wall sections 1 foot wide and 6 feet high that were subjected to fire on one side while under working load, the main object of the tests being to determine how the fire exposure affects the individual tile units. This was found to vary with the type of clay used, hardness of burning and design of the unit, from minor cracking of a few of the units in the specimen to failure under load a little after two hours.

The second group of tests was with wall specimens 4 feet wide and 4 feet high tested exposed to fire on one side, under load or restrained within the containing frames, and were made to study the effect of changes in design of the unit, and in the constituents and preparation of the clay.

Addition of up to 2 per cent. of ground burned clay (grog) to the raw clay was found to be without effect, but higher percentages increased the fire damage, apparently because of initial shrinkage cracks radiating from the raw clay decreased the tendency to cracking when exposed to fire without seriously decreasing the normal

strength of the tile. Finer grinding and greater amount of pugging of the raw clay increased the strength of the tile and consequently its load-carrying ability when exposed to fire.

Of modifications in the design of the unit, one with double outside shells improved the fire resistance for all but very dense tile in confining the cracking mainly to an outer thin shell. Increased shell thickness was also found to decrease the fire effects, as also fillets of up to one-fourth inch radius at the junctions of shells and webs.

The final series consisted of 16 fire-endurance tests and four fire and water tests of typical wall constructions, 71 of which were made with walls between 10 and 11 feet high and 8 to 16 feet wide. The thickness ranged from 8 to 16 inches, and plaster, stucco, or brick facing was applied on a number of the walls. The walls were subjected to constant loads of 70 to 120 lbs. per square inch during the fire test, were restrained within the containing frames, or were tested unrestrained, the latter condition being representative of walls in low buildings or the upper-story walls of higher buildings. The results are summarised as fire-resistance periods, which are determined by the time the walls sustained load under fire exposure and prevented the average temperature rise on the unexposed side from exceeding 139° C. (250° F.) or the maximum rise at any point where temperature measurements are taken from exceeding 180.6° C. (325° F.). Freedom from cracks or openings large enough to transmit flame or ignite combustible materials is also required both in fire-endurance tests and fire and water tests.

The final grouping of test results is in three classes determined by the design of the tile. Fire-resistance periods are given for 8, 12 and 16 inch walls in each class, the values varying with the thickness and design from $1\frac{3}{4}$ to 11 hours for unplastered walls and from 4 to 15 hours for walls plastered on both sides. Periods are also given for walls assumed to have combustible members projecting into them 4 inches from the unexposed side, this being determined by the time required for temperatures high enough to ignite wood to obtain at the given depth in the wall. Fire-resistance periods for this condition ranged from 1 hour with 8-inch unplastered walls to 10 hours with 16-inch plastered walls built of tile of the designs giving the highest results.

ECONOMIC SITUATION IN HUNGARY.

The steady economic progress which has been characteristic of Hungary in the past few years is being well maintained (says Anglo-International Bank, Ltd.).

For the fiscal year ending on the 30 June last, in spite of considerable reductions in taxation, there was a Budget surplus of approximately £3.5 millions as compared with £4.3 millions in the previous year. The total gross revenue of the Hungarian State for the period was 961.4 million pengoes (£34,336,000) which showed an increase of 60.3 million pengoes as compared with 1927, while the expenditure stood at 866.6 million pengoes, an increase of 69 million pengoes as against 1927.

The revenue actually collected during the first five months of the current fiscal year (July 1 to November 30) amounts to 422.6 million pengoes as compared with a sum of 405.5 million for the first five months in the previous fiscal year, an increase of 17.1 million pengoes. This is, of course, a considerable increase in the State revenues, which are 31.3 million pengoes larger than the estimates for the period in question, and there is no reason to fear that this improvement will not be maintained.

It is scarcely necessary to point out that Hungary is essentially an agricultural country, and that consequently the harvest plays a very important part in her economic life. Last year there was an excellent cereal harvest and the yield of some agricultural products exceeded even the pre-war figures. The production of wheat amounted to $2\frac{1}{2}$ million tons as compared with slightly over 2 million tons in the previous year, the rye crop yielded 8.3 million tons as against 5.7 million tons in 1927, while there were smaller increases in barley and oats. The exportable surplus of wheat is believed to be 1 million tons, while of the rye crop over 2 million tons is available for export. The severe drought last season however, had a serious effect on the maize, sugar, potato and fodder crops. The wine harvest was not so good last year as in previous seasons, but poultry-raising, livestock, bee farming and silk production were better.

CANADA'S MINING INDUSTRY IN 1928.

When about twenty-five years ago the engineers responsible for the location of the National Transcontinental Railway chose a route passing through Northern Ontario and Quebec in territory then considered in

the far North, the public generally accepted the proposals in the pioneer spirit and great credit was drawn from the belief that the Map of Canada had been ruled back 100 miles to the northward.

So greatly have methods of transportation advanced during the past quarter century, however, that the announcement in the early days of 1928 that various interests had made plans for prospecting in the far north of Quebec, of Ontario, of Manitoba, of Saskatchewan, of Alberta and of British Columbia, and even in portions of the Northwest Territories, adjacent to Hudson Bay, occasioned hardly any surprise. Prospectors have been dropped down from aeroplanes in areas in the far north and picked up again; supply bases have been established; and samples of ore have been brought back for assay from towns which were only yesterday many months distant from the normal current of industrial life. In 1928 money has been available in Canada for grubstaking on either a small or a large scale to an extent never before equalled, and capital has been available for surveys and underground exploration, for the sinking of large and deep shafts, and for the enlargement of milling and metallurgical facilities.

In Quebec, keen interest is now being displayed in the Chibougamau area and in the district far to the north of the International Transcontinental line. In northwestern Ontario discoveries have been reported to the east of Red Lake and to the north of Fort Hope, in the Patricia district; in Manitoba numerous new finds are recorded in the central and northern fields which may develop into ore bodies of commercial importance. In Saskatchewan a discovery of nickel copper sulphides on Rottenstone Lake is considered of sufficient value to encourage the Canadian Pacific Railway Company to plan the construction of an important branch line.

Transportation into new mining areas has made distinct strides in recent months. The aeroplane — like the prospector — changes its footwear with the seasons, using pontoons for summer and skis for winter. In addition to the extended use of the aeroplane, the use of the caterpillar tractor on snow roads has increased, particularly in Ontario and Manitoba. Even in the building of railway branch lines a distinct innovation has been made in the construction both of the Hudson Bay Railway and of the Manitoba Northern (Flin Flon) branch, sleepers and steel rails having been laid on to the frozen ground in order to permit of the transportation of thousands of tons of supplies to the terminal point before the frost has come out of the ground. By such methods the development of the Flin Flon and Sherritt-Gordon properties has been exploited in a remarkable manner.

Mining operations have made great progress in every Province of Canada :—

In Nova Scotia the coal output has been materially increased, chiefly by the development of larger markets in the St. Lawrence Valley. The gypsum industry has grown impressively. Gold mining is experiencing a revival of interest which is making possible some attempts to exploit certain of the areas (in which gold-bearing quartz veins are grouped in large numbers) as large-tonnage low-grade mining propositions. Zinc production seems a probability because of the success attending exploration at the Sterking mine. The markets for salt have expanded.

In New Brunswick, progress is also being made, the principal minerals being coal and gypsum, with smaller outputs of gas ,oil and abrasive stones. Efforts are being made to develop metal mining in the Province, and the new Mining Act of 1927 is expected to add materially in this direction.

In Quebec much attention has been attracted during the year to the developments proceeding in the Rouyn and adjoining areas of Western Quebec. Having passed through the early and highly speculative period, Rouyn is now settling down to the steady and practical development of its known ore bodies. Announcements made from time to time by the management of Noranda Mines, Limited, indicate that developments at the Horne mine and smelter have been decidedly satisfactory and should result in Noranda soon taking rank among the great copper producers of America. The more recent developments include the completion of the 500-ton concentrator and the commencement of work on a new deep shaft. The Waite-Ackerman-Montgomery has recently stepped into the ranks of producing mines with ore shipments already aggregating 2,000 tons monthly. The immediate erection of a concentrator has also been decided upon by Amulet Mines, which also reports satisfactory underground development. Operations in the areas east and north of Rouyn, notably those proceeding in the Fourniere-Malartic and Eesmeloizes areas, are being vigorously carried on. Improvement is evident in the asbestos industry in the southern part of the province; and in

respect to other minerals production is being maintained or improved.

In Ontario, the Sudbury district of Ontario, hitherto famed as the centre of the world's greatest known nickel deposits, has attracted a new permanent interest from its extensive deposits of valuable copper ores and by the results of the development work done on the lead-zinc-copper deposits of the Errington mine. Because of developments at the Frood ore-body, the properties of the International and Mond Nickel Companies together constitute one of the most important and promising base metal sources in the world. It has been estimated that there is already proven in this deposit one hundred and fifty years' supply of high-grade ore. Many millions of dollars must inevitably be expended in bringing these huge reserves to the point of production, which accomplishment will enhance the already favourable standing of the Sudbury district among the world's greatest mining centres.

The effects of the fire at the Hollinger mine and the reduced tonnage of ore milled there are shown in the falling-off of production in the Porcupine district, but increased production has been achieved in the Kirkland Lakes mines and in both areas exploratory underground work is proceeding, which has been successful in a number of cases in blocking out new reserves. These developments, taken in conjunction with the activities proceeding simultaneously at Red Lake (*e.g.* the proving of a large tonnage of commercial ore at the Howey mine), at Woman Lake, at Clearwater Lake and in other parts of the province, indicate a fairly long lease of life for the Ontario gold mining industry, and it is safe to assume that production will continue to increase.

DETERMINATION OF CrO_4 IN PAINTS.

By Edward J. Davis, Ch.E.

(Research Chemist, Coheen Corporation of New Jersey Paint Engineers.)

The following method, devised by the writer, has proved of importance in paint analysis, and there has been occasion to demonstrate its superior accuracy over the U.S. Government Paint Specifications Method. Beside being accurate, it surpasses other methods in rapidity. It is particularly helpful when CrO_4 occurs in the presence of basic lead sulphate (sublimed lead), or in the presence of Prussian Blue, both of which very often are associated with it. (Some standard methods actually fail in the presence of these two pigments.) No other pigments used in paint offer any serious difficulties to the determination.

Take 1 gm. of pigment, which has been suitably separated from the paint vehicle, and extract the CrO_4 content with KOH sol. Use 6 gm. of KOH to 50 cc. of HOH, and boil for 5 minutes, or until the residue in the beaker is colourless. Dilute to 300 cc., filter, and wash thoroughly with hot water.

Now the departure is made from the standard lengthy procedure.

Dilute the filtrate and washings to 400 cc., heat to 60° C., add concentrated CH_3COOH to neutralise, and then 15 cc. in excess. $PbCrO_4$ will be precipitated quantitatively, while Pb_3O_4, if present, will be held in solution by the CH_3COOH formed during neutralisation. Prussian Blue, if originally present, has previously been filtered off as directed above.

After standing half an hour, filter off the precipitate of $PbCrO_4$ through a Gooch, wash with hot water, dry and weigh.

If the CrO_4 is originally present at $ZnCrO_4$, add 2 gm of $PbCl_2$ just before the addition of CH_3COOH, and the CrO_4 will subsequently be precipitated as $PbCrO_4$. If no $ZnCrO_4$ is present, the Pb from the $PbCrO_4$ will obviously be sufficient to quantitatively precipitate the $PbCrO_4$, especially as there is always an excess of Pb over CrO_4 in commercial chrome yellow.

Other chemists, as well as the writer, have found this method to be accurate to within ± 0.1 per cent.

THE ADDITION COMPOUNDS OF HYDROGEN CHLORIDE WITH ETHER AND ACETONE.

By D. McIntosh, M.A., D.Sc.

(Dalhousie University, Halifax, N.S.)

Before the Nova Scotian Institute of Science.

In a paper published recently in the Bulletin of the Chemical Society of Japan, Hirai has given the results of a repetition of the work of Maass and McIntosh on the ether-hydrogen chloride system, and finds only one compound, instead of the three obtained by them. As Archibald and McIntosh have isolated and analysed one compound not found by Hirai I have examined this system again by the method of thermal analysis, and have, I believe, proved that all three compounds are formed.

The freezing-points of the various solutions were determined in a modified Beckmann apparatus with a magnetic stirrer and

a platinum resistance thermometer. The materials used were carefully purified and all solutions were made by weight. The method is described in the papers to which reference has been made.

These solutions, as Maass and McIntosh have shown, may be cooled many degrees below their true freezing-points before crystallisation takes place. This supercooling can be prevented by "inoculating" the solutions with a minute amount of the ether-hydrogen chloride or bromide complex. This causes precipitation of the $C_4H_{10}O—HCl$ or $C_4H_{10}O—2HCl$ compounds; the $C_4H_{10}O—5HCl$, which is also formed, can be separated only by cooling and prolonged stirring.

The results show maxima in the curves corresponding to the three compounds mentioned. It seems that in Hirai's experiments sufficient care was not taken in preventing supercooling.

Hirai has also examined the system acetone-hydrogen chloride, and reports but one compound, $C_3H_6O—HCl$, while Archibald and McIntosh have made and analysed the compound $(C_3H_6O)_2—5HCl$.

A few measurements were made of this two component system, and the existence of Hirai's compound and of the more complex one confirmed. These solutions, too, show the phenomenon of supercooling to a remarkable degree, and precipitation of the simpler body can be brought about by the hydrogen chloride or bromide salt.

GENERAL NOTES.

OVERSEAS TRADE.

His Majesty's Consul at Los Angeles, California (Mr. G. A. Fisher) reports that a local company desire quotations for crude naphthalene (warm pressed material for the purpose of re-subliming) and for cresylic acid (97-99 per cent. ,pale in colour and of good odour).

Firms desirous of offering British products can obtain further particulars of this enquiry upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B X 5178 should be quoted.

TREMENDOUS GAIN IN NICKEL EXPORTS FROM CANADA.

Exports of all grades of nickel from Canada in the month of January are reported as amounting to 11,508,200 pounds, valued at $2,480,424, against 5,877,900 pounds with a valuation of $1,428,567 in January, 1928.

For the calendar year 1928, Canadian nickel exports show a gain over the previous year of 37 per cent. in volume and 42 per cent. in value, a summary of the monthly figures reported by the Dominion Government showing the exports for last year as 97,166,700 pounds of nickel of all grades valued at a total of $21,782,207, these figures comparing with 70,670,700 pounds and $15,281,820 for 1927.

CANADA MAKES NEW RECORD IN MINERAL PRODUCTION.

TEN PER CENT. UP ON THE YEAR.

The increasingly important part that Canada is playing in world mineral production is eloquently illustrated by the 1928 figures which were issued recently.

A new record was set up in 1926, and another in 1927, but the 1928 output far surpasses even these years, being no less than 10.5 per cent. above 1927.

In few previous years, says the preliminary report of the Dominion Bureau of Statistics, has Canada's mining industry shown such phenomenal growth. New output records were established under the following heads :— Copper, cadmium, gold, lead, nickel, platinum group of metals, zinc, cement, coal, gypsum, petroleum.

The year's production may be summarised as follows : Metals, 131,904,000 dollars; increase, 18,000,000 dollars, or 16.2 per cent. Fuels, nearly 73,000,000 dollars; increase 1,600,000 dollars or 2.2 per cent.

Other non-metals, 18,664,000 dollars; increase 1,100,000 dollars or 6.3 per cent.

Clay products and other structural materials, 49,882,000 dollars; increase 5,000,000 dollars, or 11.3 per cent.

Total output, 273,446,000 dollars; increase 26,090,000 dollars, or 10.5 per cent.

HISTORY OF THE DEVELOPMENT OF FAST DYEING AND DYES.

By JAMES MORTON.

Paper read before the Royal Society of Arts, February 20.

Textiles are a world of their own, and it is only those who have been diretly concerned with their production or distribution that can know the inner history concerning them. But even the lay-man or woman knows that within the past two decades what is practically a world-wide revolution

has taken place in the standard of colour as applied to woven fabrics. As late as 1900 there was absolutely no standard of fastness for colour in textiles. These were made, and sold and bought, not expected to last in colour, for it had grown to be taken for granted that somehow things could not be otherwise. What do we find to-day? The public have been educated to a standard totally different, and have been led to expect and demand the colours of their fabrics to be as sound as the fibres of which they are made—a tremendous revolution in this special sphere within so short a period.

Some manufacturers and distributors have questioned the commercial wisdom of raising the standard to so high a level and of offering guarantees for fastness of colour in ordinary textiles; and as I am the original sinner, perhaps it is fitting that I should shoulder the responsibility and give the story of how it all came about.

Our firm had been makers of furnishing fabrics for some thirty or forty years—curtains, upholstery fabrics, carpets and such like. About 1902 after we moved a branch of our works from Ayrshire to Carlisle I had been interesting myself in the making of certain special tapestries. We did not then do our own dyeing, but got what was the best general service of the trade from old established dyers, and I was responsible for the colouring of these tapestries. One day in Regent Street, these tapestries caught my eye. But they had changed so radically I scarcely recognised my own handiwork. Certain colours had gone so much that the balance of my schemes had been completely upset. I was told they had been in the window for only about a week.

But I must first learn whether we were unique in our position, and whether there were not other fabrics on the market that behaved differently from ours on exposure. So I stayed in London a few days longer, and collected from friends in the trade, manufacturers' sample books of fabrics of all kinds—velvets, tapestries, damask, dress goods, window Hollands—the productions of our own country, of Germany, France, and whatever came into the London markets. So I went home with parcels of books representing many hundreds, probably thousands, of the existing colours of all classes of fabrics, chiefly cottons, mercerised cottons, linens and some silks.

I had those hundreds of colours mounted on cards with their surfaces half covered and exposed, and a warm humid atmosphere maintained. Our own fabrics were exposed with the others, and I should soon see what was the state of the colour element in fabrics as they were being supplied to the trade of the day. The result was most staggering. In many cases quite deep shades, on expensive velvets, for example, became almost white in a week. Careful notes were made on every card at stated periods, but in a few weeks there was not much more to record. Only a very few of that vast array held up any head at all after a few weeks' exposure.

It was evident that the whole colour side of our industry was in a hopelessly demoralised condition and that dyers supplied and manufacturers and merchants were willing to accept anything that coloured a fibre or a fabric, regardless altogether of its behaviour afterwards.

While making this survey of colours it so happened that I was working at the time on a new combined weaving and printing process in which I required the use of certain coloured yarns that would stand an afterresist printing process. In this connection the representative of a certain Scotch firm brought to me some pinks, "Blush Pinks," he called them, which he affirmed would "stand anything." I doubted the statement very much, especially with the experience I was just having (and as a matter of fact, the blush of the pinks did prove somewhat evanescent).

My scheme was to arrive at a range of colours that could be absolutely relied upon, and make from them certain types of fabrics that we would guarantee against fading from sunlight or from ordinary washing. So we set about dyeing many hundreds of colours in every conceivable way that would tend to secure fastness. These we exposed and tested diligently week by week, and month by month, learn- as we went along. After a certain number had given promise of the necessary qualities, made up cards of those, which I sent to a friend in India to be exposed on the roof of his house in the Punjab. I made up several sets of those cards, having alongside them corresponding shades of ordinary dyes, with instructions that they were all to be exposed uniformly, and one of the sets was to be retudned to me after the expiry of each month. This gave me the behaviour of each group from one to several months' exposure under the blazing sun of India, while at the same time we were having similar tests under our own climatic conditions. From these tests I was able by

the summer of 1904 to get as many reliable colours as formed a quite respectable palette, and by the autumn of that year we had them made into tapestries that were put on the market with a guarantee that any goods fading or failing to stand ordinary laundry wash would be at once replaced. That was the first time in the history of textiles that such a guarantee had been given.

It is interesting now to look back on that modest palette, and those of you who know anything of the history of dyes must wonder how we could launch on such a venture at that early date. But the Alizarines were good friends in those days, and if kept deep enough in shade, and dyed with care and real knowledge, they could be relied on for reds, deep wine colours, and such like. Then we had to recognise the value of some of the old mineral colouring matter which gave us some Buffs and Light Browns that were very useful. But what about Blues and Greens? For Indigo on vegetable fibre we found to be far short of the standard that would justify any sort of guarantee. At this time the first Vat colours were being put on the market—Indanthrene Blue and Yellow, also a Grey. But vat dyes were new and very sensitive and difficult to apply with any degree of levelness.

But the problem of marketing on a broader scale soon claimed our attention. We invented our trade-mark of *Sundour*, made up of the words " Sun " and " dour," the latter an old Gaelic word meaning water, and also in Scotch meaning stubborn or hard to move. And in our publicity work we founr of tremendous help those eposures that had been so exhaustively made. Our Printer friends in Carlisle made a most useful coloured lithograph of those cards of exposure whereby we could show at a glance the comparative(result of ordinary dyes and our *Sundour* dyes, the former showing almost white in three weeks, while the *Sundours* had stood firm at the end of their seven months' exposure.

Up to this time we had only tacked the dyeing of those special colours on yarns for cloths that we had become more or less indentified with, and by this time I felt that we were, perhaps, reaching the limit of the trade that could be done in this particular field—mainly tapestries and fancy types of hangings. But at that time there was a great demand for plain dyed piece goods. It was a business of very great volume in Lancashire, and I felt that if we could adapt our special features to this particular branch it would enable us to tap the grey cloth production of Lancashire and give us fabrics on a much lower basis of cost that would appeal to a vastly greater public. In the meantime, stimulated as I thing the makers in Germany would willingly admit, by the market we had helped to create for them, the scope of dyes of the Vat type had greatly increased; but their application had been confined to yarns, and I realised the enormous value that would accrue if they could be applied to the vast grey piece trade. This involved a set of problems that had never yet been tackled, and it is here that a new chapter in our story begins.

These prohlems were of a kind that could not be undertaken by our friends in Scotland who had been dyeing our yarns, so I decided that we should make these new developments in dyeing within our own works at Carlisle. This involved the starting of a chemical side of our business, and was in the year 1909. As a preliminary, I visted personally the Principals of our three main Technical Colleges—Leeds, Bradford and Manchester—stated my problem and asked for their recommendation, from among their present or past students that might be available for our important post. It was an interesting and instructive time, and I ultimately fixed on the recommendation of Dr. Knecht of Manchester, in the person of Dr. Teltscher, a graduate of Heidelberg University ,who, besides having taken his Ph.D., there in Pure Science, had taken a Tinctorial and Textile Course at Manchester, as well as a short similar Course in Germany. He became known to many in Carlisle and delivered several interesting Scientific Papers there, and was an active and interesting personality among us till he left for Vienna on the Sunday before the outbreak of War.

With his collaboration we ultimately worked out a special process for the application of Vat and other colours to plain cloth, first from laboratory models, which we afterwards developed into works' plant from our own drawings, and from which we dyed and issued from our own works in Carlisle the first whole or plain vat dyed goods in this country, and the first practical production of its kind, I believe, in any country, for Germany had not yet got to the stage of applying these colours in that form.

The introduction of these plain dyed fabrics made a much greater impression on

the market than anything we had done before. They appealed to a much wider public, and, as you can easily realise, to offer a perfectly plain cloth guaranteed against fading was a much bolder thing than a multi-coloured patterned fabric—any fading would be so instantly visible. It got Lancashire manufacturers by the ears—who would ever think of guaranteeing plain dyed cloths such as they had been turning out by the mile in their easy way all these years—and they foretold early disaster to the firm that would venture on so wild a scheme.

But we went our way. The orders rolled in and the machines went up till we began to be felt by the big Lancashire and Yorkshire makers. And when they realised that the road we had taken did not seem to be leading to utter destruction they began to offer us a little of their company, so that to a small extent before 1914, and in a much greater degree during these later years, we have got many companions on the way, here, and even more largely in America, each decorated with his own peculiar badge or banner, as like the original as they could go—the word "Sun" or "Sol" or "Dour," with every variety of prefix and affix, but none of them just the plain *Sundour*. From a perusal of the trade papers one would indeed think we had become a people of sun worshippers!

And we have made welcome all this company so long as they were leal and true to the standard. For what is the meaning of it all? It means that the public apathy has been roused, and if manufacturers are to get their share of the trade they must now work to a completely new standard of colour, for the public has at last been taught to demand, because they know they can get the colour element of the fabrics they use as stable and reliable as the fibres they are made of—which is indeed the goal of the crusade we set out upon those years ago.

But the realisation of all this sustained a rude shock in the very height of the effort, and while we were still almost alone in the field. The threads of our web were suddenly snapped, and the gathering up of these threads and re-starting of the web will be the subject of the second chapter of my story. But before I start on that, it may be interesting for you to know something of the progress we had made up to that date and some of the satisfaction it had already brought to us.

By 1914, though we had had a progressive business in many departments of textiles for some forty or fifty years, this section of *Sundour* has become by far the largest and not the least lucrative. And what about reputation? How had the guarantee fared? This is most interesting. At first we felt that it would be only prudent to lay aside a certain reserve out of profits against goods that were going out in such quantities with a guarantee for every yard, but after the first two years we found that this was entirely unnecessary. I do not say we had no complaints, for much may happen where so many operations are subject to the human factor; but our tests were so rigid, and our decision to use at all times only the best known procurable dyes by the best known processes regardless of cost was so effective, that the percentage of misfits in a year was so infinitesimal as to be quite negligible. As to reputation, I could read many letters that came to us from all parts of the globe testifying to the wonderful behaviour of our fabrics. They were a great encouragement to us in those early days. To give many of them would only weary you, but as a matter of scientific interest to some of the chemists here it may not be out of place to read one or two of these comments just to show what properly dyed colours on sound cloths can stand. Take this from smoky Pittsburgh, U.S.A., written from the chief store there, in October, 1910, to our New York house:—

"Feeling quite sure that you would be interested in regard to the wearing qualities of your *Sundour* fabrics we are sending to you a strip used as a window panel. Said panel has been in use for the past five years on the sixth floor window, southern exposure, and has been washed twenty times or more in our own laundry in the ordinary way. Prior to cleaning, these curtains on each occasion were black with greasy soot common to this locality, which heretofore has been the cause of taking both life and colour out of every fabric tested.

"Would like if you would carry a surplus of this *Sundour* cloth in New York as we are constantly running out of some of the colours. Will guarantee taking double our mail order if this will be any inducement to you to carry stock of our colours."

This Nigerian experience may be of special interest, written to a friend in London and forwarded to us :—

" Ten months ago a friend of mine called here on his way out to Southern Nigeria. He had been there for a number of years, coming home at intervals. On seeing *Sundour* fabrics he was inclined to pooh-pooh the idea of their being fadeless and offered to fade them for me. I gave him samples, which I have received back this morning. He had split them in two, locking one set in an airtight case used in the jungle, and exposing the other to sun, win and rain for seven months close to the equator. He writes now to say that he is a convinced believer, and the samples sent back speak for themselves. These I am sending to you as I thought they would interest you."

The following is a rather romantic episode of some *Sundour* curtains which we have now at the works. They were brought back by one of our Directors who was visiting a friend in Yorkshire, and for the purpose of this paper I wrote this gentleman to give me the story of them. This is what he says :—

" The curtains you ask about were supplied in April, 1913, and hung at the windows of our yacht. In 1914 the yacht was given to the Admiralty, and was in constant use all through the War in various waters. When the boat was sent back, the curtains, along with the other things, were black and greasy. My wife had been rather partial to those curtains, and thought, why not try a washing of them? After thorough washing they were rehung and looked as good as new. This was in 1918, and they have been worn constantly since on all our cruises, and would be now, had not Mr. Murray, on his visit to us this summer, 1928, begged to have them as a *Sundour* keepsake."

But one must not hurrah too soon! We never know what may be in front of us. A few months ago some cloth came back with complaint that it showed fading. We investigated and found that it had been supplied some nineteen years ago. The chief defect was that the fibres were badly chafed, but after washing, the colours were found to be so good that we kept the cloth as a splendid proof of stability, and sent the party new material. I need not add, perhaps, that this communication came from Aberdeen!

(*To be continued.*)

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

SYNOPSES OF PAPERS PRESENTED AT THE TWENTY-FIRST ANNUAL MEETING.

(*Continued from page* 201.)

The Importance of Design and Setting of Large Kettles Used for Refining and Low Melting-Point Alloys. By HARRY C. LANCASTER, Member of Council, Director and Technical Advisor, Locke, Lancaster and W. W. and R. Johnson & Sons, Ltd., and the Associated Lead Manufacturers.

The author dealt with some of the problems met with in increasing the size of kettles from 20 tons to 50 tons capacity, and shows how the larger units require radical alteration in design to be successful in practice. It is also demonstrated that close attention to details has given increased life to the kettles themselves, with consequent reduction in the cost of the metal treated.

An Improved Form of Electric Resistance Furnace. By W. ROSENHAIN, D.Sc., F.R.S., President, Superintendent, Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory; AND W. E. PRYTHERCH, M.Sc., Members Assistant, Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory.

An electric resistance furnace is described for which advantages are claimed in regard to higher available working temperatures (up to 1400° C.), durability, and freedom from oxidation of the carbon resistor. The heating element of this type of furnace consists of carbon or graphite pellets, or short rods placed end to end in a refractory sheathing tube which fits easily over them. Heating occurs by contact resistance. The sheathing tube prevents the access of air sufficiently to avoid any appreciable burning of the carbon.

Recent Developments in Electric Furnaces. By D. F. CAMPBELL, M.A., A.R.S.M., Member, Campbell and Gifford, Consulting Engineers, London.

The paper describes the improvements and modifications in melting practice during the last two years, and discusses the relative performance of small and large induction furnaces, and the reasons for selecting the size of unit according to the work to be done.

A short description of improvements in practice with high-frequency furnaces and details of new methods of lining these furnaces are given. A general survey of heat-treatment furnaces follows, with a detailed description of the construction and performance of a number of specific furnaces, including a continuous furnace for annealing brass strip. The largest brass works, where electricity is utilised more than elsewhere, is described, with explanation of the uses to which electricity has been applied; with diagrams showing the energy consumed and the effect of the special precautions used to improve power and load factor.

Alloys of Zirconium. II. By C. SYKES, M.Sc., Ph.D. (Metropolitan-Vickers Research Scholar, The University, Sheeld).

Measurements of certain electrical and magnetic properties of copper-zirconium, iron-zirconium, and nickel-zirconium alloys are given. These show that the addition of zirconium leads to no material improvement in the properties of the metals, and in certain cases is detrimental.

Two further partial series of binary alloys are described, *viz.*, aluminium-zirconium and silver-zirconium. The systems exhibit little solubility in the solid state at room temperatures and intermetallic compounds are formed. In the low-percentage alloys, *viz.*, 10 per cent., the compounds crystallise in the form of long, fine needles, and consequently the structure of the alloys is very coarse. Hardness figures for aluminium and silver-zirconium alloys are given, together with measurements of tensile strength, ductility, corrodibility, and resistivity of the aluminium alloys.

The Resistance of Zinc to Indentation (A Preliminary Account). By J. NEWTON FRIEND, D.Sc., Ph.D., F.I.C., Member, Head, Department of Chemistry, Central Technical College, Birmingham; AND W. E. THORNYCROFT, B.Sc., Member, Department of Chemistry, Central Technical College, Birmingham.

A machine is described for determining the rate of indentation of zinc by a steel conical die acting under small gravity loads. For the range of loads employed the relation, at constant temperature, between depth of indentation, D, applied load, L, and duration, θ, of application of load is given approximately by

$$D = aL^p\theta^m,$$

where a is the depth of indentation produced by a load of 1 kg. acting for 1 sec., and p is a constant. The nature of m requires further investigation. The a-temperature curve shows a change in direction at 160°-170° C., which is significant, in view of the supposed allotropy of zinc in this region.

The Solution of Plain and Amalgamated Zincs in Electric Batteries. By J. NEWTON FRIEND, D.Sc., Ph.D., F.I.C., Member, Head, Department of Chemistry, Central Technical College, Birmingham.

It is shown that for use in electric batteries with dilute sulphuric acid or with saturated ammonium chloride solutions plain high-grade 99.9 per cent. zinc cannot satisfactorily replace the amalgamated metal; neither is there any material advantage in using amalgamated pure zinc instead of amalgamated ordinary commercial 98 to 99 per cent. zinc.

The Silver Contents of Specimens of Ancient and Mediæval Lead. By J. NEWTON FRIEND, D.Sc., Ph.D., F.I.C., Member, Head, Department of Chemistry, Central Technical College, Birmingham; AND W. E. THORNEYCROFT, B.Sc., Member, Department of Chemistry, Central Technical College, Birmingham.

The silver contents of 20 specimens of ancient, Roman, and mediæval lead have been determiued. Spartan lead votive figurines, *circa* 700 to 500 B.C., were found to 0.0568 per cent. silver, or 18½ oz. silver per ton. The pre-Roman lead does not appear to have undergone any treatment for desilverisation.

THE CHEMICAL SOCIETY.

ANNUAL MEETING: PRESIDENTIAL ADDRESS.

The Annual General Meeting of the Chemical Society was held on March 21, at the University, Leeds. Prof. J. F. Thorpe, F.R.S., delivered the Presidential Address, taking as his subject, "The Scientist in Industry." He pointed out that the age was at hand, if it were not already here, in which the changing Governments would no longer be able to determine major policies, as of war, financial and fiscal, except in directions approved by organised industry. Control by those who held the keys of national prosperity, that is, of organised industry, was one of the alternatives to class control and was not only a desirable but also an eminently practicable ideal. To achieve it science and industry must organise

so that they might become strong politically and financially.

Apart from more purely chemical or scientific factors there were two immediate advantages to be gained by the formation of big combines, in the pooling of capital and of engineering resources; the establishment of a balance in commodities produced and in the method used for their production being determined mainly by chemical and engineering resources and experience, because many of the new processes which had been devised in recent times depended more on good engineering for their success than on any other factor. The chemist called on the engineer for workmanship, design and material of the very highest class, and it was precisely in these directions that our engineering science excelled. This was particularly true of modern high-pressure processes, none of which was in existence till the end of the War. It was not too much to say that in this branch of chemical engineering Great Britain now led the world.

The chemical trade was at present in the midst of the most rapid expansion it had ever known, and nowhere was the development more noticeable that on the research side. The researchers were the scouts and it was essential that they should be far ahead of the army, the working process. It was necessary also that the scouts should operate on a broad front in order that no channel of advance should be overlooked merely because it did not lie in the expected direction. The realisation of this principle by the greater manufacturers had led to a strong demand for university-trained men, and the number of research chemists in industrdy in this country had been estimated at 20 times the number before the War; the demand was still increasing. The universities had had and were having their work cut out to supply this larger number of adequately trained men, for they had to fulfil the majority if not all the demands made by chemical industry. Manufacturers had come to realise that training should be essentially fundamental and that a wide knowledge of the principles of chemical science was a necessity.

Every head of a research school knew that he could always place a thoroughly trained man, and he was frequently in the position of having no men available when application was made to him for research workers. It was, therefore, very disquieting to realise that the policy of the Department in connection with the provision of maintenance grants for students in training appeared to be changing, for, whereas the number of such grants (including research workers and assistants) was 275 in 1925-26, it had fallen to 186 in 1927-28. The outlook was serious because it was quite impossible for the universities to provide funds for post-graduate training in any way commensurate with the present-day requirements of industry, and as the average science student was usually drawn from a comparatively poor class it was not likely that the necessary money for an extended course would always be obtainable from parental sources. No doubt in the future the universities would be able to acquire adequate funds for this purpose from benefactors who appreciated the need. but that time was not yet come.

Prof. Thorpe also dealt with the co-operation of industry with science and with the application of scientific methods in industry.

MINERALOGICAL SOCIETY.

March 19.

Dr. G. T. Prior, President in the chair.

Inclusions in the Apatites of Some Igneous Rocks. By Dr. A. W. Groves and Mr. A. E. Mourant.

Apatite crystals with dark cores of inclusions have been observed among the heavy minerals of some English sedimentary rocks, but there are few records of such apatites in igneous rocks. The authors record several such occurrences in granites and in volcanic rocks from Normandy, Jersey, and Brittany. Five different types are distinguished in the granite of northern Brittany alone. In one type with a definitely pleochroic core the inclusions appear to consist of biotite or chlorite, but in other types it has not been possible to determine their nature.

Calc-gneisses and Cordierite-sillimanite-gneisses of Coimbatore Madras Pres., and of Similar Occurrences in India. By Mr. L. A. Narayana Iyer.

The paper dealt with a suite of crystalline gneisses in the ancient Archæan complex of India of Dharwar age (Huronian), consisting of the above two facies, which are in close association. Similar suites of rock occur in different parts of India, forming a definite stratigraphic horizon. The author considers their formation as due to thermal or "infra-plutonic" metamorphism followed or accompanied by regional or dynamo-thermal metamorphism of pelitic schists and calcarous sediments.

A Relation Between the Density and Refractive Index of Silicate Glasses with Application to the Determination of Imitation Gem-stones. By MR. F. A. BANNISTER.

The study of simple glass families leads to a relation between the refractive index and density which can be applied in a modified form to the determination of imitation gem-stones. n - N/d - D, where N and D are the refractive index and density of silica glass, is plotted against n by a simple graphical method whereupon the various imitations separate into groups; the members comprising any onegroup are chemically similar. Doubtful cases can be solved by measuring in addition the relative dispersion.

The Crystallisation of Potash-Alum. By MR. H. E. BUCKLEY.

The author described the results of experiments on the differences of crystal habit obtained under varying conditions of cooling, and evaporation, and in the presence of various substances in solution.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Synthesis of Some Benzophenone Derivatives. I. Chlorohydroxybenzophenone. By MOSUKE HAYASHI.

Synthesis of Some Benzophenone Derivatives. II. Chlorohydroxymethylbenzophenone. By MOSUKE HAYASHI.

Observation on Pinene of Cunninghamia Konishi *Hayata.* By TESSAKU IKEDA AND YASUJI FUJITA.

Hydration of Pinene by Bertarm-Walbaum Method. By YASUJI FUJITA.

Alkaloids of Fritillaria verticillata, *Willd. var* Thunbergii, *Baker.* By MASAO FUKUDA.

NOTICES OF BOOKS.

Industrial Carbon. By C. L. MANTELL, Ph.D. Pp. x + 410. London : Chapman & Hall. 1929. Price 21s.

The element carbon plays an important [illegible] *rôle* in science, industry and everyday life. give[illegible] its elementary and allotropic forms, [illegible] from uses as fuel, it is used in most where a [illegible] ways. As the diamond it is the duced by a [illegible] stance known. As graphite it is [illegible] ftest and is used (as a lubricant) to make the world run more smoothly in an age of hustle. Graphite (made in large and ever-increasing amounts as well as the natural product) finds other applications, in crucibles, bencils, and polishes.

Finally the many varieties of amorphous carbon—animal charcoal, wood charcoal, lamp-black, etc., find uses in many processes and industries. All these Dr. Mantell describes fully in the 29 chapters of his interesting book which is a valuable addition to the Industrial Chemical Monographs.

Enzyme Actions and Properties. By PROF. ERNST WALDSCHMIDT-LEITZ. Translated and extended by R. P. WALTON. Pp. xviii + 255. London : Chapman & Hall. 1929. Price 20s.

The phenomena of enzyme actions represent a specially prominent aspect of the modern developments in Organic Chemistry. The mechanism of these chemical transformations taking place in the life processes of micro-organisms and indeed in all living matter are principally due to enzymes. Whilst primarilly of bio-chemical interest, the study of enzymes has a much wider importance, many industries being dependent upon the control of these catalytic agents. From the scientific side greater interest has been manifested in enzyme action since Prof. Willstätter carried out his researches in this field. His pupil, Prof. E. Waldschmidt-Leitz, wrote an able account of our present knowledge of the subject and this is now available in English translation. This volume will doubtless receive the attention of biologists, biochemists, organic chemists and others interested in enzyme action.

Institut International de Chimie Solvay. Troisième Conseil de Chimie, Bruxelles, Avril, 1928. Rapports et Discussions sur des uestions d'Actualité, publiés par MM. Les Secrétaires du Conseil. Gauthier-Villars & Cie., 55, Quai des Grands-Augustins, Paris. Pp. 560. 1929. Price 70 fr.

L'Institut international de Chimie Solvay, dont la création est l'œuvre de M. Ernest Solvay et dont l'avenir est assuré par la famille Solvay, a pour but principal d'organiser, tous les trois ans à Bruxelles, des Conseils de Chimie. Le Comité scientifique de l'Institut détermine un an à l'avance le programme de ces Conseils et désigne la personnalité scientifique chargée de faire les rapports, ainsi que celles qui sont invitées aux discussions. Les objets à l'ordre du jour sont choisis parmi les questions d'actualité pour lesquelles la discussion pourrait devoir être fructueuse.

Le troisième Conseil de Chimie Solvay a siégé du 12 au 18 avril dernier sous la présidence de Sir William Pope. Les rapports suivants y ont été présenté et discutés :

Actions chimiques dans la décharge électrique, par M. E. K. Rideal.

Les formes actives des éléments, par M. W. Mund.

La sensibilisation photochimique, par M. Berthond.

La sensibilité photographique, par M. Slater Price.

Théorie thermodynamique de quelques équilibres au contact de membranes semi-perméables, par M. F. G. Donnan.

La perméabilité des membranes; ses effets physiques et chimiques, par M. P. Girard.

Les valences chimiques, par M. G. Urbain.

Valence Variable, par M. N. V. Sidgwick.

Radicaux libres et composés non saturés, par M. P. Wolden.

Recherches sur les hydrates de carbone complexes, par M. P. Karrer.

Les rapports ainsi que les comptes rendus des discussions de ce troisième Conseil de Chimie on été réunis et publiés par les soins des secrétaires et de la Commission de publication de l'Institut, en un volume de 562 pages, dans lequel on trouvera aussi les statuts de l'Institut international de Chimie Solvay, la composition de ses commissions et la liste des participants au troisième Conseil de Chimie.

Directory of Paper Makers of Great Britain and Ireland. Price 5s. 6d. nett, post free in U.K.

We have received a copy of the 1929 issue of this publication, which has again been authentically revised and brought up to date by inclusion of changes since the 1928 number appeared and it will be noticed that many changes have taken place since the previous issue. For those connected with the industry and its ramifications the Directory is specially useful.

PUBLICATIONS RECEIVED.

Annual Report of the Director of the U.S. Geological Survey, 1928.

U.S. Geological Survey : Water-Supply Paper 586. *Surface Water Supply of the United States.* Part VI. Missouri River Basin. By Nathan C. Grover, W. A. Lamb, R. Follansbee, C. G. Paulsen, J. B. Spiegel, H. C. Beckman and H. B. Kinnison. 50 cents.

Water Supply Paper 588. Part VIII. *Western Gulf of Mexico Basin.* By N. C. Grover and C. E. Ellsworth. 25 cents.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

8,034.—British Celanese, Ltd.—Preparation of oxygenated organic compounds. March 12.

8,491.—Distilleries des Deux-Sevres.—Extraction of acetic acid from pyroligneous acid. March 16.

8,584.—Distilleries des Deux-Sevres.—Extraction of acetic acid from pyroligneous acid. March 16.

8,389.—I. G. Farbenindustrie Akt.-Ges. —Synthesis of ammonia. March 14.

8,390.—I. G. Farbenindustrie Akt.-Ges. Manufacture of alkyl cellulose esters. March 14th.

Specifications Published.

307,528.—Jenkins, W. J., and Imperial Chemical Industries, Ltd.—Nitrocellulose products.

307,531.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Manufacture of sulphonic acids of N-aceto-acetylated aryl amines.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

304,688.—Sulphuric acid.—Mansfeld Akt.-Ges. fur Bergbau und Huttenbetrieb, Eisleben, Krebs, H., Hettstedt, and Borchers, R., Burgorner, near Hettstedt, all in Germany.

In manufacturing sulphuric acid, particularly by the intensive system, lead is replaced by iron, steel or iron alloys in the construction of the apparatus.

A packed tower of use in the Petersen system, consists of an iron container containing a packing material on a perforated iron plate resting upon pillars of iron acid-proof material.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

SPEEDLIEF.

498,904.—Chemical substances prepared for use in medicine and pharmacy.—John Wellwood, 132 and 134, Grosvenor Road, Belfast, Northern Ireland. March 6.

MALVIN.

499,223.—Chemical substances prepared for use in medicine and pharmacy.—Garnett Brothers, Limited, 16, Howard Street, Rotherham. March 6.

MICAREME.

499,259.—All goods in class 3, which includes chemical substances prepared for use in medicine and pharmacy.—Micasox, Limited, 66 to 70, Chandos House, Buckingham Gate, London, S.W.1. March 6.

ORTO.

496,071.—All goods in Class 1, which includes chemical substances.—Hill Brothers Glass Company, Ltd., 67 to 69, Summer Lane, Birmingham. March 20.

VONBA.

498,609.—Chemical substances prepared for use in medicine and pharmacy.—Mary Ida Buckle, trading as Vonba Company, Brooms House, Grafton, York. March 20.

SYNOBLAIN.

499,422.—All goods in class 3, which includes chemical substances prepared for use in medicine and pharmacy.—Synot Limited, Imperial House, 80 to 86, Regent Street, London, W.1. March 20.

STRONGFORT.

499,723.—Chemical substances prepared for use in medicine and pharmacy.—Nathoo Valabhji Shah, trading as Indian Drug & Perfumery Company, 303, Juma Musjid, Bombay, India. March 20.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered througn any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3600.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES :

Administrative : Central 6521.
Printing Works : Hop 2404.

CONTENTS. PAGE.

An Atomic Model for the Chemist. X. 225
By Florence Langworthy.

Physical Constants 228

Electromagnetic Energy Relations ... 227

Sir Oliver Lodge on Energy 229

Canada's Mining Industry in 1928...... 231

History of the Development of Fast Dyeing and Dyes 232
By James Morton.

Proceedings & Notices of Societies :—

Society of Glass Technology 235

Notices of Books 236

Forthcoming Events 238

New Patents 239

New Trade Marks 240

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 28/- net.

AN ATOMIC MODEL FOR THE CHEMIST. X.

By FLORENCE LANGWORTHY.

In *The Scientific Worker*, Dec., 1928, the reviewer of Mr. J. W. N. Sullivan's book, *The Bases of Modern Science*, quotes the following passage : " The ideal aim of science, we are told, is to give a complete mathematical description of phenomena in terms of the fewest principles and entities." Then he comments thus :— " It is dangerous to give complete assent to such an assertion simply because, to Mr. Sullivan, much of the stress is on the word mathematical. In fact, he restricts his attention almost entirely to mathematical physics, casting a mere cursory glance at chemistry, except where it broaches on the physical side and turning his back severely on all branches of biology. One might prefer to say that the ideal aim of science is to connect up the phenomena of nature into the minimum number of independent chains of causal events."

The physicist is certainly becoming obsessed with his mathematics. If an atomic model satisfied him mathematically, it may be doubted whether he would care whether it threw any light on the problems of chemistry although the atom is so fundamental that a correct model of it must throw light on these problems. A love of mathematics tends to take a man away from the actual. In one of the latest books by Sir James Jeans, for example, the mathematics are based upon a most improbable origin for our planetary system. We have to picture a most " unusual " accident—the close approach of another sun to ours. Professor Eddington writes :— " The data are too vague to give any definite estimate of the odds against this occurrence, but I should judge that perhaps not one in a hundred millions of stars can have undergone this experience in the right stage and conditions to result in the formation of a system of planets." (*The Nature of the Physical World*, p. 177.)

And so we are told by Sir James Jeans—as one improbability leads to another—that planetary systems are very rare in the universe. Newton did not go to work in this way. He saw the apple fall. There are plenty of apples falling—in other words, there are plenty of facts and probabilities for our modern mathematicians to exercise their genius upon. If they were to base their work upon such facts and probabilities there would be less risk of its collapsing like a house of cards. I quote the following from

the *Times Literary Supplement* (Nov. 29, 1928) :— " The theory of the atom proposed by Schrödinger restored our hopes, but only so long as the theory was misunderstood. Professor Eddington, in a first-rate popular exposition of Schrödinger's theory, shows that it is not a physical theory at all, but only a mathematical dodge." Instead of keeping close to facts and probabilities, our physicists seem sometimes to avoid them of set purpose. Let us consider the Bohr atomic model, for instance. Thanks to Sir Ernest Rutherford we know that the atom is like a solar system with the sun at the centre, and also that the force of electrical attraction between this sun and a planet is inversely proportional to the square of the distance between them. What is probable, then, is that a planet of such a system is composed of positives and negatives albeit only one positive and one negative—even as our own planet has both. Our physicists, however, avoided the probable and accepted the Bohr atomic model which gave us negative electrons *only* for planets. Then again, although our physicists see with their own eyes that it is the sun that radiates light, and that, therefore, in all likelihood, it is the atomic sun that radiates light, they must needs make the atomic planets responsible for light waves. According to the Bohr atom a ray of light originates when one of these planets jumps from an outer orbit to an inner one. It is not surprising that the Bohr atomic model is now discredited seeing that the great work of Sir Ernest Rutherford was distorted by such improbabilities. And why had our physicists accepted it? Because it could be made, apparently, by these distortions to throw light on the Balmer lines. And yet they had the opportunity of choosing my atomic model instead, which keeps close to probability and explains the Balmer lines in a much simpler and more credible way than did the Bohr atomic model. Had our physicists accepted it they would not now be suffering the surprise of finding out that the cathode ray is not an electron, pure and simple, for this atomic model showed me that it was a negative particle composed of one positive electron (not a proton) and two negative electrons. It also showed me that the negative electron, pure and simple, only makes its appearance in photo-electricity and radioactivity. In my book, published in 1926, I submitted the evidence in favour of the cathode ray being a negative particle and not merely a negative electron so as to confirm further what my atomic model indicated. Thus by adhering to probability I was brought nearer to the truth than all the mathematicians. But to little purpose, I fear, for now we are told that physics will " no longer take its flight, as it were, from the world of ordinary experience," but " will make contact with the world only at the end of its flight." And so we may expect some more theories to come crashing down, for you can no more build a sound theory without taking into account the world of ordinary experience than you can build a sound aeroplane.

Since our physicists have thus betaken themselves to the clouds, it all the more behoves the chemists to keep close to the solid ground of fact and probability. Thus they will help to preserve the great work of Sir Ernest Rutherford, which will otherwise be lost, for the " waves will wash it down." Let such words as " waves " and " æther " be anathema to them. What will become of the Beta particle of radioactivity that Sir Ernest Rutherford thought so little like a " wave " that he described it as a particle even when it was in all the excitement of being shot from the atom? According to the New Quantum theory it will be a train of waves. The hydrogen atom, instead of having an electron revolving about it, will have an atmosphere of negative electricity encircling it! This theory will take us back to the old days when electricity was thought to be a fluid. The electron, as such, is to pass out of existence, simply because the cathode particle in its ray state has been found to give rise to a diffraction effect. As I have shown, the cathode particle is apparently a positive electron with two negative electrons revolving about it and making it negative. These two negative electrons will naturally repel each other on emerging from any place in which they have been forced together and thus would give rise to a diffraction effect. But the negative electron is not the cathode particle and should not—without a good deal more investigation—be treated as one. My atomic model has shown me that the negative electron exists—the positive electron also—and that it is quite distinct from the cathode particle. And why I have faith in my atomic model is because it has been built up in a reasonable way. We know what problems an atomic model has to solve in physics, chemistry, etc., and therefore in building up a model we must cast aside all models that do not solve them. Our physicists accepted the Bohr atomic model because it apparently gave an answer to the puzzle of the Balmer

lines if we would consent to believe the incredible. I myself would not have thought of offering my atomic model to the Cavendish Laboratory if it had not faced far more than one problem and found answers that entailed no strain on one's power of belief. I am certain of one thing and that is that if we abandon the electron or, in other words, convert it into "waves," physics will suffer. Everywhere we find that Nature is discrete from sun to atom, but she will lose her discreteness if we accept the New Quantum Theory. Professor Eddington starts his outline of the same in the following words :— "Imagine a sub-æther whose surface is covered with ripples. The oscillations of the ripples are a million times faster than those of visible light—too fast to come within the scope of our gross experience." I, for one, refuse to imagine a sub-æther, or any kind of æther, and have no use for ripples or "waves" in physics. The word "ray" will serve. We have our cathode ray which we can look upon, when unexcited, as the cathode particle, though possibly this material existence will be denied it. Why should this be? One does *not deny the material existence* of the helium atom because it can—on escaping from the atom—take the shape of an Alpha *ray*. I have shown that an L X-ray can, in all probability, become a hydrogen atom. And since helium and hydrogen are yielded up by the disintegrating atom then the atom itself—of which hydrogen and helium are parts—is indicated as being the light *ray*. That is to say the atom—from lithium upwards—can be an atom-*ray* as well as an atom, albeit in the ray state it will lose most of its mass owing to the excitement of *all* its negative and positive electrons. As it is the mere mention of waves seems to destroy clarity of thought. Even Professor Eddington writes : "Light-waves in passing a massive body such as the sun are deflected through a small angle. This is additional evidence that the Newtonian picture of gravitation as a tug is inadequate. You cannot deflect *waves* by tugging at them, and clearly another representation of the agency which deflects them must be found." (*The Nature of the Physical World*, p. 122). Newton did not picture waves but corpuscles. That matter can act upon matter we know and the attraction of the sun's great mass on the small mass of the corpuscles is surely best likened to a tug. Professor Eddington is apparently referring to the undulatory theory not to the Newtonian. If light is a mere twitching of the æther, taking its rise from the jump of an electron from an outer to an inner orbit in some atom or other, then one certainly could not picture any "pull" or "tug" as taking place. The undulatory theory has been the old man of the sea to physics and the less we have to do with its phraseology the better.

Thus with my atomic model the atom can be two things—it can be an atom of matter or it can be an atom-ray of light. In order to be the latter it must be acted upon by a sun, either by the suns in the universe or by the suns in the atoms. This action will take the shape of depriving it of a negative particle (a cathode ray) if it is an atom, or of a negative atom if it is a molecule, and then repelling it as a positive. Thrown off in this fashion the atom-rays have all their charges excited—every positive and negative electron within them—and so they will be in a different condition from that in which they would be when merely ionised, when just one planet, the chief planet—that is to say the boron planet in the boron atom or the oxygen planet in the oxygen atom—and so on—is excited.

ELECTROMAGNETIC ENERGY RELATIONS.

Journal of the Optical Society of America and Review of Scientific Instruments, January, 1929, W. E. Deming gives a short article with a table and chart of the electromagnetic energy relations. For example, the shortest possible wave-length from an oscillating electron on the classical theory is of the order of 10^{-4}A. Cosmic rays, $\lambda = 0.0004574$, $4H \longrightarrow He$, middle part of cosmic ray zone. Coalition of electron and proton, $\lambda = 0.0001815$A, the frequency falling between 10^{23} and 10^{24}. In compiling the chart the following values for well-known constants were used :—

$c = 3 \times 10^{10}$.
$e = 4.774 \times 10^{-10}$.
$m_0 = 8.999 \times 10^{-28}$.
$h = 6.554 \times 10^{-27}$.
$k = 1.372 \times 10^{-16}$.
$N_0 = 6.061 \times 10^{-23}$.
$H = 1.00778$.
$He = 4.00216$.
300 volts = one E.S.U.
potential difference.
One Calorie $= 4.186 \times 10^7$ ergs.

The truer value of c is so near to the one above that the rounded-off figure (3) is evidently used to facilitate calculation, as is largely customary.

This condensed article is a small mine of information and all students interested in modern advances in physics should secure a copy of the journal, price 60 cents.

PHYSICAL CONSTANTS.

R. T. Birge in the *Physical Review* for February, 1929, vol. 33, p. 265, *gives his* re-calculations of the general physical constants as follows :—

$c = (2.99796 \pm 0.00004) \times 10^{10}$.
$G = (6.664 \pm 0.002) \times 10^{-8}$.
Litre $= 1000.027 \pm 0.001$ cm^3
$H = 1.00777 \pm 0.00002$.
$He = 4.0022 \pm 0.0004$.
$Ag = 107.880 \pm 0.001$.
Int. ohm $= (1.00051 \pm 0.00002)$ *abs. ohm.*
Int. amp. $= 0.99995 \pm 0.00005$ *abs. amp.*
$A_n = (1.013249 \pm 0.000003) \times 10^6$
$A_{45} = (1.013199 \pm 0.000003) \times 10^6$
$v_n = (22.4141 \pm 0.0004) \times 10^3$ cm.^{3} *mole*$^{-1}$ $=$ 22.4135 ± 0.0004 *litre mole*$^{-1}$.
$T_0 = 273.18 \pm 0.03°$C.
$J_{15} = 4.1852 \pm 0.0006$ *abs. joules.*
$J_{20} = 4.1813 \pm 0.0006$ *abs. joules.*
$J'_{15} = 4.1835 \pm 0.0007$ *int. joules.*
$J'_{20} = 4.1796 \pm 0.0007$ *int. joules.*
$F = 96489 \pm 5$ *abs. coul.* $=$ 96494 ± 1 *int. coul.*
$e = (4.770 \pm 0.005) \times 10^{-10}$ *abs.* E.S.U.
e/m (spectroscopic) $= (1.761 \pm 0.001) \times 10^7$ *abs.* E.M.U.
e/m (deflection) $= (1.769 \pm 0.002) \times 10^7$.
$h = (6.547 \pm 0.009) \times 10^{-27}$.

E. Bäcklin has recently determined the value of e and he obtains a figure somewhat higher than Millikan's value (4.774×10^{-10}). I have not seen the paper yet, but it is to be noted that many of the above values are so dependent upon one another, when making the calculations, that a further revision may be necessary in view of later work as intimated.

It will be seen that the value above for h is appreciably lower than Birge's best previous value.

Aston's value for He was 4.00216. In the table of atomic weights for the current year it is given as 4.002_2. The previous chemical determination was 4.000. I should think that it would be better to adhere to *one value* pending a new determination in which case He could be given as He $= 4.002_{16}$.

Since compiling the above I see that E. Bäcklin (*Nature*, March 16, 1929, p. 409)—after referring to Eddington's hypothesis concerning the electron—gives his value of e as 4.793×10^{-10} E.S.U. $\pm 0.3\%$ (E. Bäcklin, *Upsala Universitits Aarsskrift*, May, 1928). A. P. R. Wadlund (*Phys. Rev.*, Dec., 1928, vol. 32, p. 841) obtained by means of a method similar to that of Bäcklin the value 4.774×10^{-10} E.S.U. $\pm 0.15\%$, which agrees exactly with Millikan's classical value. The arithmetical mean of the three values here cited is 4.780. This is close to a value I preferred, *viz.*, 4.779×10^{-10}, but, obviously, the *exact* agreements mean nothing, yet if a value must be taken this mean one would be, in my opinion, the best to take in the circumstances, certainly better than going to one extreme or to the other.

Now it appears that Wadlund (*loc. cit.*), in a check calculation, worked with the older value of c; but if the new precision value 2.99796×10^{10} be taken, then his check value comes out at 4.7728×10^{-10}. Assuming that this would apply in Millikan's case, owing to the suggested equality stated above, then the arithmetical mean of 4.7728 taken twice plus 4.793 is 4.7795. I should explain that Bäcklin discusses Wadlund's values, but he does not raise the point here noted.

The last-mentioned equality might be questioned with good reason, but be this as it may, there are unspecified factors which govern the net result, and to take them all into proper account would involve a good deal of study and further precision experimentation. This being the case, the approximate mean value seems to me to be as good as could be expected in the circumstances, and using the value 4.779 keeps within the range of error given by Millikan himself.

H. Feder (*Ann. der Physik*, 1929, p. 497, *current issue*) has arrived at a new value for h, but it rests upon the value of e, so taking e as $(4.776 \pm 0.008) \times 10^{-10}$ h is $(6.551 \pm 0.015) \times 10^{-27}$. Elsewhere in this paper h is given as 6.547 ± 0.008 when e is 4.774, neglecting the multipliers here. The following ratios would seem to apply closely :—

$$6.547 : 4.774 = 6.551 : 4.7769,$$

therefore—

$$6.547 : 4.774 = 6.55\dot{6} : 4.7810.$$

The last two values are those which I have been advocating in these columns, the last one being practically 4.779, as the experimental errors preclude an exact calculation; or, to put it the other way,

$$6.5498 : 4.774 = 6.55\dot{6} : 4.7790,$$

whereby it will be seen that the first value, 6.5498, comes within the range of error given by Feder, his highest value being 6.55, say.

H. S. Allen in his THE QUANTUM AND ITS INTERPRETATION, 1928, pp. 58, 165, 166, 174 to 178, discusses the values of h and e.

H. S. Allen has laid so much stress on the relation of h/e representing a unit or quantum magnetic tube of force (see book

cited above) that I have tried to imagine a magnetic line growing out of an electrostatic line in the sense that if two pins were inserted (say, two inches apart) in a drawing-board and an elastic band stretched over them, this would represent the electrostatic force acting on, or between the two pins. Now if this system were made to move in a direction parallel with the axes of the pins at the velocity c, it is assumed that the band would be stretched into a circle just touching the pins, this representing the unit magnetic line of force or tube. Such a model is not, of course, a material one in the general meaning of matter; nor does it meet experimental requirements, for it shows one principle in a faulty way as regards the model representation. This is so obvious it could not be mistaken for reality. Models are so faulty that they are more or less ignored by mathematicians.

Returning to the argument, here are two systems of units involved, the E.S.U. and the E.M.U., while the distance between the pins goes 3 times and a little over in the circle. If the *distance over* is important, then it can be calculated from the constants, h, e, c, and 8×10^{-25}, according to the equation :—

$$\{(8 \times 10^{-25})/(h/c)[h/(e/c)]\} + 3 = \pi,$$

when $h = 6.55\dot{6} \times 10^{-27}$ erg. sec.
$e = 4.779 \times 10^{-10}$ E.S.U.
$c = 2.99796 = 10^{10}$ cms. per sec.
$\pi = 3.14176$ by this calculation, there being an error of 0.00017.

Keeping to the above values for h and c, but taking a lower one for e, *viz.* : 4.776×10^{-10} brings about a practically exact value for the decimal fraction of π, but *I have no faith in this type of calculation—it merely shows an effort that might be improved* upon. However, I regard h, taken as $6.55\dot{6}$, as fixed by the equation,

$$c = R_\infty / (24 \times 10^{-33}/h).$$

It is of passing interest to note that π can be computed to 7 places of decimals by the simple equation, $\pi = 3 + 8/(56.5001)$.

F. H. L.

(*To be continued.*)

COSMIC RAYS.

R. A. Millikan and G. H. Cameron in the *Physical Review* for February, 1929, vol. 33, p. 266, report that from another attempt to find directional effects in cosmic rays they conclude that such an effect cannot be more than two or three per cent. at the most in the intensity of the radiation studied.

SIR OLIVER LODGE ON ENERGY.

Sir Oliver Lodge in his little book ENERGY, 1929, gives expression to some remarkably interesting ideas, as the following *citations show* :—

" Only those, however, who are familiar with mathematics can appreciate the beauty and intricacy of the reasoning of the great masters of science; who seek to apprehend the intimate working of such laws of nature as have so far been disclosed, who express the strains, velocities, and forces in operation, by means of recondite equations, and who then solve the equatious in accordance with fixed rules, and deduce from them a multitude of previously unsuspected consequences. The intellect required for such mastery over natural processes seems almost a different order from that common to the sons of man."—Page 19.

" The accurate mathematical specification—the second law of thermodynamics—is statistical, too. Statistical and probability treatments, though still much in favour at present, are after all confessions of comparative impotence, and may be regarded as a temporary expedient to tide over the periods of uncertainty and comparative ignorance about essential and intimate and unobservable details. Nevertheless such ideas are useful and perhaps unavoidable at present, though mostly outside the scope of this book."—P. 26.

" An increase of entropy occurs whenever heat runs downhill from hot to cold without doing work. If heat is transmitted from hot to cold by a perfect engine, then there is no change of entropy on the whole transaction. No energy is then dissipated, it is all utilised; and the pristine conditions could be restored by reversing the operation and working the engine as a pump. When energy is dissipated, as by heat conduction from a hot body to a cold, the entropy (as at present defined) increases. Entropy has been defined so that it is lessened in a body which loses heat and increased in a body which gains it."—P. 27.

" Magnetism is one manifestation of a current, and is believed to be a spinning form of energy; while light is a vibratory form, simultaneously electric and magnetic."—P. 36.

" One outcome of the Theory of Relativity is that there is no absolute distinction to be drawn between matter and other forms of energy so that what we perceive as motion of matter may be interpreted as but a residual etheric phenomenon in which

some fraction of the unmodified ether is entangled with the modified portion that we call matter, so as to increase its mass and give us the effect of movement. Locomotion is a thing that demands further explanation. Its absolute meaning is unknown. As observed, is is always relative."—P. 48.

Sir Oliver Lodge on p. 53 says that the atom cannot go off in a flash of radiation on the earth, the annihilation of matter and the corresponding appearance of radiation being a stellar phenomenon

"In addition to that, there is a small amount of energy developed by radio-active substances in the crust of the earth, which is responsible for the sporadic or occasional displays of volcanoes, earthquakes, and hot springs."—P. 57.

"There are some who surmise that it may be the same with life [referring to energy]. It is possible that life exists primarily in the ether, that it only enters into relation with matter in secondary fashion for a time, and then returns whence it came. But this at present is a speculation outside the realm of physics."—P. 62.

"Meanwhile as regards energy, we know that only the kinetic energies, locomotion, rotation, and vibration, exist in matter. The static energy of strain, or elasticity, exists in the connecting medium, or ether; and so does the energy of light, of electricity, and of magnetism. The fact is that, looking at the universe or cosmos as a whole, matter seems to play but a small part in it. It may be important in quality, but not in extent. The cosmos is for the most part empty space. Only here and there do we find a material body. In the heavens the stars have been likened to grains of dust or minute particles of sand, distributed sparsely, so that an interval of 200 yards exists between them."—P. 62.

"Perhaps the greatest of recent discoveries is the quantum, but its introduction throws ultimate explanation into the background, for it introduces a fresh element of unintelligibility. Nevertheless, faith in intelligibility is the standard of science, and the stimulus to further exploration; we must not be discouraged by difficulties of observation and apprehension."—P. 64.

"Conceivably an electron is ether in a state of internal stress, which differentiates it from the rest and individualises it."—P. 70.

"So also, though much less obviously, a falling weight is being pushed down by the strained ether, and is receiving energy from it."—P. 72.

"There is therefore no gain of energy in any activity, only a transfer. One body or one portion of the body gains what the other body or the other portion loses. The energy is merely transferred from one to the other, just as, in an act of purchase or gift, money or goods are merely transferred from one to another. And this is the law of conservation of energy, which seems to hold without exception. We see that it is closely connected with Newton's third law, one of the most comprehensive laws that we know of, and one which has led to remarkable deductions. —P. 73.

"Life does not appear to be a form of energy, nor is it responsible for a supply of energy : it merely utilises and directs pre-existent energy."—P. 76.

"It may well be that life and mind exist in the ether. Yet we know that the laws of physics apply also to the ether; and how or by what means the mind acts on the physical universe, even on the ether, we have as yet no idea."—P. 77.

"To assimilate the produce of centuries of powerful thought, by the ablest minds in all countries, needs special aptitude and a lifetime of study. But mice may nibble where lions feed."—P. 79.

These quotations, isolated here as paragraphs, only touch the subjects discussed, so that the reader will do well to peruse the whole book which is written in a simple and elegant style.

TRANSMUTATION OF CHEMICAL ELEMENTS.

L. Thomassen in the *Physical Review* for February, 1929, vol. 33, p. 229, in a nine-page paper reports that experiments were made to effect the transmutation of certain elements according to the previous experiments of others. X-rays were tried but without results in favour of any transmutation. The experiments of Smits and Karssen yielded apparent results, but Thomassen was unable to confirm them, except that a trace of Hg was found in the residue, but this is attributed to initial Hg-impurity and not a transmutation : Pb⟶Hg.

Thomassen did not try bombarding chemical mixtures on the X-ray-tube target as I did, but so much experimental work has been done that had anything of this kind taken place it would have been generally observed unless it should be a sort of chance effect which would require great time to bring about and then be very sporadic. See *Chemical News*, Dec. 8, 1926, p. 356.

F. H. L.

CANADA'S MINING INDUSTRY IN 1928.

(*Continued from page* 212.)

Manitoba and Saskatchewan—Second in importance to the Sudbury developments only are those taking place in northern Manitoba and Saskatchewan, centering on the boundary between these Provinces. Here, as elsewhere in the Dominion, mining is once more the medium through which new country is being opened up and reclaimed from the wilderness. In order that the Flin Flon and adjacent properties might be developed, eighty-five miles of railway have been carried over difficult country from Mile 7 on the Hudson Bay Railway to the Flin Flon property. The arrival of steel at the latter point has enabled the Hudson Bay Mining and Smelting Company to advance its plans for the development of its power plant at Island Falls on the Churchill River, some seventy miles worthwest of the mine, and arrangements have been completed for the delivery of 25,000 tons of construction material to the power site by the end of March. These activities give strength to the report that the Company is planning on having the turning-on of power coincide with plant installations which will place the Flin Flon mine on a producing basis, probably in 1930. As these developments indicate, the Flin Flon is a very important, if low grade, proposition. It has been said that this property ranks with the largest base metal deposits o fthe Dominion, ranking only below the Sullivan mine of Consolidated Smelters and the Creighton and Frood orebodies of the Sudbury area. At the Mandy mine, four miles south of Flin Flon, an extensive programme of underground work is being carried on. At the Sherritt-Gordon on Cold Lake, thirty-five miles to the north-east of Flin Flon, extensive underground work and diamond drilling has been done and a sufficiently large tonnage of low grade copper-zinc ore is reported to have been disclosed to warrant intensive development and to add another producer to Canada's already impressive base metal list.

Noteworthy progress has also been achieved during the year in the south central fields of Manitoba. Central Manitoba is reported to be finally established on a productive basis, with a gold output, for the month of August and the first half of September, valued at over $60,000. A good deal of development work has been done in 1928 on this and other properties in this and the Rice Lake field, and exploration in the Rice Lake, English Brook, Bird River and Slate Lake areas has been general.

In Alberta the outstanding event of the year was the striking of an immense flow of natural gas on October 31 in the Meridian No. 1 well on the Alberta-Saskatchewan boundary south of Lloydminster. This "blower" marks the discovery of a new natural gas field, known as the Ribstone area, in which drilling has been carried on for oil following the publication of a report on the structure of this region by Dr. G. S. Hume, of the Geological Survey, Department of Mines. Gas from this well, measured two days after the strike, was flowing at the rate of nearly eleven million cubic feet daily. Further examination will determine whether the well wil lalso be a producer of oil. Somewhat earlier McLeod No. 4 in the Turner Valley, a wet-gas producer, was brought in with a tested flow of over twenty million cubic feet daily, and as this is being written it seems probable from information coming to hand that the Okalta well will vie with Royalite No. 4 for progress has not been so marked, and it is to be hoped that the test movements of coal to points in Central Canada authorised by the Dominion Government will result in widening the existing market for the output of the Alberta mines.

In British Columbia the intensive activity prevalent in mining is exemplified in the recent report covering the operations of the Consolidated Mining and Smelting Company for the first nine months of 1928. During this period the company produced 117,884 tons of lead, 59,353 tons of zinc, 7,687 tons of copper, 153 tons of cadmium, 19,656 ounces of gold and 5,677,433 ounces of silver. To provide for its growing needs the Consolidated Mining and Smelting Company is reported to be planning for additions to its Trail smelter which would permit of the handling of a further 500 tons of concentrates daily, and to increase the milling capacity of its Kimberley concentrator, at the Sullivan mine, from 4,000 to 6,000 tons a day. The Consolidated programme is representative of conditions in the mining industry throughout the Province. The number of new shipping mines has been enlarged and a number of new finds reported, some of which are believed to be of importance. In the northern and coast districts, as well as in the Kootenays, heavy expenditures have been made for mine development and for increased milling and milling facilities, and these various

activities will most likely be reflected in the gross tonnage output for the year, which for British Columbia will no doubt establish a number of high records.

Mining and Metallurgy. Progress and expansion in milling and metallurgical facilities continue throughout the Dominion to keep pace with the advance made in other phases of the mining industry. In many cases, and notably in the gold districts of Kirkland Lake and southeastern Manitoba and in the case of the complex non-ferrous ores of British Columbia, the progress made in milling practice, in concentration methods of ore treatment and in metallurgical practice of ore reduction has been to a large extent responsible for the increased output of the metals.

The allied iron and steel industry, too, is participating in the general expansion of business and is establishing creditable production.

Hydroelectric power developments. The Canadian mining industry has a very intimate relation with the development and transmission of hydro-electric power, and indeed metal mining n Canada would be on a very restricted scale, but for the remarkable fact that in few mineral-producing areas had the promoters of mining enterprises failed to find hard by water power sites capable of being developed for the production of cheap electrical energy. At the moment the outstanding hydro-electric power development related to mining and metallurgical operations is the project of the West Kootenay Power Company to develop 80,000 horse-power on the Pend Oreille River at a point near the international boundary south of Trail, B.C. Continuous expansion at the Trail smelter and development of mining in the interior of British Columbia necessitates the addition of this huge plant, which will require about two years for completion. Another project, with 10,000 horse power output, is planned by the East Kootenay Power Company at Phillips Canyon on the Elk River, the energy from which will also be utilised mainly by mining enterprises in south-eastern British Columbia. A reference has already been made to the projected construction of the Flin Flon power plant at Island Falls, on the Churchill River, Saskatchewan some seventy miles north-west of the mine. It is of interest to note that this development when carried into effect, will be the first water-power development in the Province of Saskatchewan. It is designed to develop about 40,000 horse-power.

It has recently been stated by the Department of the Interior that 5,000,000 horse-power has been developed for the mining industry from water power; and the further statement that there is still available 38,000,000 horse-power from unharnessed water power opens up an interesting line of thought as to the opportunities still available for the exploitation of out-of-the-way ore bodies and low grade ores.

Mineral production increases — Mineral production figures for the first half of 1928 show a satisfactory increase as compared with the first half of 1927, and the general expectation that the calendar year 1928 would establish another record was confirmed by the issue, early in January by the Dominion Bureau of Statistics at Ottawa of its Preliminary Estimate indicating a production value for the 12 months totalling $271,000,000, an increase of no less than 10 per cent. over the figures for 1927. The development in the Canadian mining industry in recent years has, however, not yet been reflected in production and dividend figures to the extent which may reasonably be anticipated very shortly, though Canadian business is reaping the first fruits of this expansion in heavy purchase of equipment and supplies.

GENERAL NOTES.

HISTORY OF THE DEVELOPMENT OF FAST DYEING AND DYES.

By James Morton.

Paper read before the Royal Society of Arts, February 20.

(*Continued from page* 219.)

In quite another department of life the fame of *Sundour* colours seems to have found its way, and it may be of interest to tell that in the famous Army manœvres in Germany in 1913, the capes and caps of the Emperor, his sons and Field marshals, were all made of *Sundour* material dyed and woven at our works in Carlisle, and supplied by Messrs. Burberry, because they had been found to stand their most rigorous weather tests.

Just one other incident also relating to Germany, which I must give at this stage, mainly because of a rather interesting sequel, but which does not come until much later in my story.

We were on very good business terms with the German dyemakers, and in the Vat

section would be by far the best customers in this country. We had collaborated with them a good deal with a view to getting materials that would meet our very special requirements. In the autumn of 1913 there was an important new phase that I was keen to develop, so it was arranged that I would spend some time over there with our head chemist in order to go through some experiments, and we had a most interesting trip. Our time, I may say, was spent in the Application Laboratories, the actual manufacturing sheds being sacrosanct. At the Badische works at Ludwigshafen we had a specially interesting time, and as it was from these works that we had been drawing most of our supplies during all those years my name and our affairs seemed to be somewhat well-known to them, and they had by them many specimens of our productions as a matter of technical interest. In showing us round their Hall of Honour, Dr. Bohn, I think it was, pointed to an empty niche in the gallery, and in a jocular way explained that that niche was being reserved for Mr. Morton, as they recognised it was to him more than anyone living that they were indebted for the commercial development of these Vat colours—a nice little jocular compliment with a sequel which, as I have said, you will hear of later on.

I took the results of the experiments of our sojourn home with me. They were going through their usual tests, and for the next few months we were preparing for this new development. The holidays of July came, and then it was the August of 1914 and—the scene had changed.

It is difficult to know just how to begin this second part of my story, for I sometimes rub my eyes even yet, and wonder whether it is not all a dream and it is really is true that one has been responsible for what is now known as Scottish Dyes, with its huge buildings and railway avenues spreading over some fifty odd acres of land, dealing with thousands of tons a year of raw products to be converted into Intermediates and dyestuffs of the most complicated types, by dozens of skilled chemists, with hundreds of chemical process men, and employing something like a million sterling of good capital.

Much has been said at different times as to the condition in which manufacturers in this country found themselves when suddenly deprived of the supply of German dyes, but from what I have already said, you will agree that no firm, perhaps, was more hardly hit than we were. While we had our own special plant and processes of application, we had grown to be almost entirely dependent on Germany for the supply of these special products. We had developed a big and progressive world trade, and moreover, we had just formed that section of our business into a separate Company for its further development—Morton Sundour Fabrics Limited. Should we have to pull down our Fast-Dye Flag, the work of all those years? Not except under direst necessity. But just what to do? In spite of the dislocation of everything by War, trade somehow kept coming in, and stocks of dye materials were rapidly diminishing. No one among us had ever troubled to know the chemistry of these dyes—we had had enough to do with application. Very little literature was available. But as in other things at that time, this crust of ignorance must somehow be broken, and this was our plan.

In the last resort we could again revert to some of our earlier types of dyes, materials for which were all available in this country. But as in the earlier days, the crux again was the blues and the yellows, and their combination into greens. If we could get hold of just these two dyestuffs we could carry on, and our flag should not go down.

Our Head Dyer, thought he was not a University man and would not be considered a very profound or exact chemist, had a certain flair for things chemical in many directions, that came in most opportunely at this juncture, and was of great value to me in those early stages. We traced out the synthesis of those two dyestuffs, and found that they were both derived from 2-amino-anthraquinone, a word that was the purest Hebrew to me at that time, but which for many days to come I had to assimilate with my morning coffee. The blue was apparently got by fusing this 2-amino with caustic potash, and the yellow by treating the same substance with antimony-pentachloride in nitrobenzene.

This mysterious 2-amino-anthraquinone was derived from anthraquinone-2-sulphonic acid sodium salt, more commonly known as "Silver Salt," which I learned was the basis of alizarine. Here I felt was a distinct ray of hope. At Silvertown, on the Thames, was the British Alizarine Company, who had been large makers of alibarine for many years, and I felt, surely here were the people to tackle the manufacture of these essential dyestuffs—they were already halfway there. So with this new knowledge I got into imdemiate touch with this Company. It was

n hopes they might already have started on he problem; but this only resulted in my being told that they had done nothing in he direction of these colours, nor could I persuade them to consider doing so.

I then visited the other dye-making concerns to learn whether they were doing or had intentions of doing anything towards the manufacture of these Vat colours, but their reply was in the same strain. They were busy on the manufacture of general dyestuffs, so much in demand, also with some essential acids for War purposes, and they could not consider taking up anything to intricate or exclusive as the Vat dyes.

So I went home to "chew the cud," and to see whether amongst all our new activities, it would be possible to add this further difficult problem. For by this time we had already among other things, undertaken the manufacture of a fairly large number of Army blankets, so urgently wanted at that time. We decided, however, that if we could procure the silver salt we really would set out and try to do the rest of the processes ourselves—I was determined that we should have that blue and yellow, though they should cost us their weight in gold. But it was imperative to get more definite and detailed information as to manufacture. There were no books on these recent dyes, and Patent Specifications were not to be had. The only source of information was the Patents Library in London, and I was lucky in procuring the services there of a good chemical reader, who spent many hours and days extracting for us the necessary details of the various patents involved. And thus we were enabled to see something of the road before us.

I then approached again our friends at Silvertown—the British Alizarine Company—this time for a different purpose. I explained my project, and the worthy Dr. Bendix looked mildly amused. In the end, however, he let me have my silver salt and and from the smile on his face, I am sure he felt it was like giving a schoolboy what he asked just to humour him, and that no more would be heard of it. So I got the precious silver salt home, and our fun began. We had now to convert it into the 2-amino-anthraquinone which, as I told you, is the basis of our coveted yellow and blue. But what did this mean? It involved one of the most difficult operations in chemical manufacture, and one that had never been done in this country—indeed the means for it did not exist. It involved the heating of the silver salt under a pressure of from 600 to 800 lbs. per sq. inch, or 35 to 40 atmospheres with ammonia at a temperature of from 180° to 200°C. By dint of great luck we had available a little old autoclave made of Krupp steel, and which had been procured years before for quite a different kind of purpose. It held about 1½ litres, with solid cover held down by clamps, and what was best of all, had a splendid all steel pressure gauge and safety valve.

One cannot go into all the interesting and exciting details of these first days and nights, but suffice it to say that we at last got our little autoclave to yield us a quite respectable 2-amino-anthraquinone, with its long orange needles, or crystals, and by early November, just three months after War began, we had actually produced Indanthrene Yellow G., and in a few days later, the Indanthrene Blue—only a few grammes of each, and I am afraid not of the purest, but we had worked out the processes and knew something of the road we had to travel, or, shall I say, as much of it as was good for us then to know.

We had then to consider plant, and it made me smile when looking up my notebook the other day in connection with this paper to read the modest list of requirements that was to form the first chemical plant in this country for the making of Vat dyes—a few hundred pounds sterling in all. The chief problem, as you may imagine, was the autoclave. We decided to make it of a size to hold a charge of 8 cwts., and a steel vessel of that capacity to stand a working pressure of 40 atmospheres at about 200° C. had never been thought of in this country. However, with the help of a good local engineer we made as careful a design as we could for an autoclave complete with stirring gear, pressure gauge, thermometer, tube pockets, safety valves, etc., and the casting was put into the hands of a London Company to whom we had been specially recommended. It was a long wait for this vessel, but meantime the other plant was getting ready, and we kept getting experience with our little autoclave, making a charge every day without fail, and the cupfuls of blue and yellow colour thus got were not to be despised. At last, some time in January, 1915, the wonderful autoclave was ready, and I went South to see the tydraulic test. But it was no good. The material used had been too porous, and moreover it had other faults in construction, where the makers had departed from our design, and we decided that we could never take the risk of a charge with ammonia at

the temperature necessary. This was our first adverse blow.

In our extremities we heard from an engineer of a certain vessel in London that might be adapted to this high pressure and temperature, and we lost several weeks in adapting this, but to find it also was insufficient.

It was at this time I heard that one of the big dye firms had a vessel that might do such work, and I went at once to see if they could extend us temporary accommodation. I mention the incident because of its effect in other ways. The gentleman I saw seemed astonished at my visit and my request. What were we up to This was a chemical operation, and we were only weavers, and something more, rather in disparagement of people like ourselves trying to make dyes, especially dyes requiring such processes. From my after knowledge I learned that he really had no plant that could have helped us, so that his methods may have been by way of a screen, or bluff. But it had the effect of putting further fight into me, and "Begad," I said to my friend who was waiting outside, "I will let that man see yet whether weavers can make dyes." The next time we met was some four years later, after much water had flowed under the bridges. We had been asked to speak together on the same platform at an important chemical meeting in London, and no one could have been more complimentary to our accomplishments than he was on that occasion.

(To be continued.)

DEPARTMENT OF OVERSEAS TRADE.

We are advised by the above Department that the office of His Majesty's Trade Commissioner at Wellington reports that a firm in Auckland is desirous of being placed in touch with United Kingdom manufacturers of steam and formaldehyde disinfectors for mattresses, etc., and of hospital equipment and apparatus generally.

Firms desirous of offering goods of British manufacture can obtain further particulars of this enquiry on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 5201 should be quoted.

"THE ANALYST."

CHANGE OF ADDRESS.

The editorial office of *The Analyst* has been moved from its previous address as from March 19, and all Journals, Correspondence, etc., to the Editor or Advertisement Manager should be adddressed to 85, Eccleston Square, London, S.W.1.

TRADE COMMISSIONER IN THE IRISH FREE STATE.

The Department of Overseas Trade notifies that it has been decided to establish a Trade Commissioner post (Grade I) in the Irish Free State with headquarters at Dublin and to appoint Mr. W. Peters, C.M.G. to the new post.

Mr. Peters was appointed Commercial Secretary Grade II for Russia in July, 1919, and was promoted to be Commercial Secretary Grade I for Siberia in February, 1921. He was appointed Assistant Agent of the British Commercial Mission to Russia in July, 1921, and returned to England on the withdrawal of the British Mission from Russia in June, 1927. He was appointed Commercial Secretary Grade I for Sweden and Denmark in January, 1928, but as from October, 1928, his area was limited to Sweden.

Mr. Peters expects to leave England for Dublin about the middle of April. A further announcement regarding the opening of the new post and the address of the Trade Commissioner's office will be made later.

Proceedings and Notices of Societies

SOCIETY OF GLASS TECHNOLOGY.

The 115th meeting of the Society of Glass Technology was held in the University, Leeds, on Wednesday, March 20, the President, Mr. Walter Butterworth, Senr., M.A., in the chair.

The following two papers were presented:

Investigations into the Erosion of Tank Blocks. By F. F. S. BRYSON, M.B.E., M.A., B.Sc., F.Inst.P.

The subject matter of this paper had formed one report issued in the thirteenth *Bulletin* of the Glass Research Association in 1925.

A method was described of determining the rate of erosion of tank blocks while in position in a furnace actually in operation. The investigations were carried out at a works in the London area, the tank being oil-fired and worked for the melting of white bottle glass.

Sixteen thermocouples were inserted into the interior of blocks forming the side wall of the tank, and one into the bridge. The couples were placed as near as possible to a depth of 7 inches in each block which was 8 inches thick, thus leaving 1 inch of block between the couple and the glass. Continuous records of the temperatures of the vari-

ous couples were made throughout the life of the furnace.

Shortly after the furnace was lit, air-cooling was installed. The rate of increase of the temperature of any couple indicated the rate of erosion of the block at that particular point.

The temperature records, plotted against the time from the beginning of the investigations were shown on lantern slides, and the regions of equal erosion in the blocks were also shown graphically. The results were summarised as follows :—

(1) The air-cooling resulted in a lowering of temperature of the outer, and, to some extent, of the inner walls, but it was not evident that a layer of chilled glass was formed on the inner surface of a block of only 4 inches thickness.

(2) The temperature of the glass in contact with the top blocks permitted of currents being formed in the glass, thus aiding solution. The movements of the glass near the bridge were different from those near the doghouse, as was evidenced by the difference in the nature of the erosion in the two regions.

(3) The glass temperature varied, due to the variations in the amount of glass being worked out.

(4) The rate of erosion near the glass level was very rapid at first, then the rate fell; at a depth of 10 inches below the glass surface, the rate was not so rapid, while at a depth of 16 inches it was slow.

(5) At the glass level the attack was most severe seven feet from the bridge.

(6) The surface temperature of the glass was greatest about midway between the doghouse and the bridge, while at the bottom of the tank the temperature was highest near the bridge end.

The Selection of Coal for Gas Producers. By E. J. C. Bowmaker, B.Sc., and J. D. Cauwood, M.Sc.

Mr. Bowmaker presented this paper, stating that laboratory tests were carried out on some two dozen coal samples and the results obtained were compared with the performances of the coals in actual use in the producers.

In each case the usual proximate analysis was done, including moisture, volatile matter, ash, and fixed carbon. The methods used in these determinations were described. From considerations of the volatile matter values, the coals could be classified as cannel, anthracite, abituminous; the ash values determined the economic value of the coal; and the fixed carbon indicated whether or not the coal was likely to form a deep fire bed.

The sample of coal yielding the most satisfactory results in the producer was found to contain 36 per cent. volatile, with an ash content of 3 per cent. The standard specification finally chosen was not more than 5 per cent. ash; volatile matter between 35 and 38 per cent.

Many coals fell in this class, yet were unsatisfactory due to "caking." After much experimental work it was found that the determination of the amount of a coal dissolved out by treatment with boiling aniline in a Soxhlet extractor yielded results which were in agreement with the "caking" tendencies, determined in another set of experiments, and also from the producer action. Coals which were definitely classed as non-caking yielded aniline soluble values below 6 per cent. : while solubilities in aniline of over 10 per cent. were definitely associated with non-caking coals. One exception only was encountered. A cannel coal yielded a solubility in aniline of 12 per cent.

Further investigations on the softening points and the ferric oxide contents of the ash yielded proof that in all cases but one the fusing points were proportioned to the iron oxide contents. The exceptional case was an ash containing 70 per cent. ferric oxide.

The following specification was given for a good producer coal :

Ash not to exceed 5 per cent., volatile matter 35-38 per cent.; solubility in aniline not to exceed 7 per cent. under the conditions stated; the iron oxide content of the ash not to exceed 15 per cent.

The last figure was liable to variation according to the method of working the producer.

NOTICES OF BOOKS.

Handbook of Chemistry and Physics. By Charles D. Hodgman and Norbert A. Lange. Thirteenth Edition. Pp. 1216 + blank pages for notes. Chemical Rubber Publishing Co., Cleveland, Ohio, U.S.A. 1929. Price $5.

This invaluable Handbook of Chemistry and Physics is really a compilation of data, mathematical tables, general chemical and physical constants, solubility tables, 'properties of matter,' heat, hygrometric and barometric tables, sound, electricity and magnetism, light, photography and general laboratory recipes.

The general features and scheme of arrangement remain substantially the same

in the latest edition although much new matter has been added, especially in the sections dealing with the specific gravity of aqueous solutions. A section devoted to ceramics has been added and among the remaining new information mention may be made of the alcohol tables giving specific gravity referred to water at the same temperature and the data on sound absorption. An attempt has thus been made to include all essential material in every branch of chemistry and physics. As a handy reference guide the work is invaluable.

The Collection of Czechoslovak Chemical Communications.

Under the editorship of Profs. Heyrovsky and Votocek the first three numbers of the *Collection of Czechoslovak Chemical Communications* have already appeared and it is possible for scientists to form an idea of the work being done in the Universities and Technical Institutes in Czechoslovakia as indicated by the memoirs appearing in the *Collection* each month.

The March issue, in addition to four original articles, contains a bibliography of the books and papers in pure and applied chemistry written either by Czechoslovak chemists or emanating from Czechoslovak scientific laboratories and published during 1928.

Prof. Baborovsky of Brno has continued his studies upon the hydration of ions and cognate work.

Dr. Balas and his collaborators have examined a number of resins of pharmaceutical interest, whilst Dr. Bures has studied a number of plant extracts and natural bases with their derivatives.

Dr. Dedek has published a number of papers on sugar chemistry dealing with the value of activated carbons, surface tension and adsorption.

Prof. Heyrovsky and his collaborators have continued their physical investigations on reductions and depositions at the dropping mercury cathode with the help of the auto-registering polarographic attachment.

Prof. J. Formanek published several papers on the influence of substituents in the colour and absorption spectra of indigo and allied dyes.

Prof. C. Krauz continued a number of investigations on the isomeric trinitrotoluenes, tartaric acid as a stabiliser for smokeless powders, the softening point of resins, etc.

Prof. Krepelka has given a revised value for the atomic weight of arsenic.

Prof. Kubelka has analysed a number of tannins from the standpoint of their application in the tanning industry.

Dr. Sveda has worked out new microchemical methods of analysis for copper and tin. Dr. Tomicek has examined the methods for estimating bromides and iodides in excess of other salts with special reference to the analysis of natural mineral waters.

Prof. Votocek has carried out further work on the chemistry of the sugars especially some of the lesser known types.

Altogether this bibliography, compiled by Prof. Simek includes about 250 original articles, etc., and shows that Czechoslovak chemists are engaged in investigations covering almost every branch of chemistry.

J. G. F. D.

Abderhalden's Handbuch der biologischen Arbeitsmethoden. Abt. I., Teil 2, 2 Hälfte, Heft 3. *Sulfonieren.* By J. Halberkann and F. Fretwurst; and *Biologisch wichtige Reaktionen and Reagenzien.* By E. Strauss and K. Koulen. Pp. 1969-2148 + xvi. Berlin and Vienna: Urban and Schwarzenberg. 1929. Price 10 marks.

The papers combined in *Lieferung* 287 of Prof. Abderhalden's comprehensive handbook on Biological technique are of unequal length and value, and the section on Sulphonation, which occupies most of the issue, covers fully the methods adopted by organic chemists to introduce SO_3H (and SO_2H) into different types of compounds. The varied conditions have been studied and the survey is an excellent one.

The chemical reactions and reagents which a biologist is supposed to be likely to meet are very cursorily mentioned in a systematic manner and it is suggested that Kahlbaum's and Merck's chemicals are preferable for use owing to their purity.

SCHOOL BOOKS.

The Cambridge University Press will shortly publish a volume of *Selections from Carlyle,* edited, with an Introduction, by Mr. A. H. R. Ball, Senior English Master at Liverpool Collegiate School, and editor of *Ruskin as Literary Critic* published last year. The aim of the volume is to collect and arrange the passages most representative of Carlyle's contribution to culture and to thought, particularly in the spheres of Literary Criticism, Philosophy, Political Economy, and History.

Mr. N. F. Watterson, Senior Science Master, West Suffolk County School, Bury St. Edmunds, has written a small text-book on *Elementary Qualitative and Volumetric*

Analysis, which the Cambridge University Press wil lshortly publish. The book is intended for the scholar's own use, under the direction of the teacher.

A Course of English Poetry, by Mr. J. H. Francis, Senior English Master, County School for Boys, Barry, will shortly be published by the Cambridge University Press. Each chapter deals with a particular style or period, and contains considerable extracts from English poetry accompanied by explanatory matter, questions, and exercises.

Forthcoming Events.

TWELFTH EXPOSITION OF CHEMICAL INDUSTRIES.

NEW YORK, MAY 6, 1929.

The development of a Food Processing Equipment Section at the Twelfth Exposition of Chemical Industries, to be held at Grand Central Palace, New York, week of May 6, 1929, has brought together between 150 and 200 exhibitors whose products are directly applicable in the industry of processing and preparing foods, as well as the various by-products of this industry.

The manufacturer will find much that is of interest to him and the most up-to-date methods of merchandising and marketing of food products. One of the outstanding features of this section will be an oven control developed by a large baking company. This control can be applied to other industries. Similar applications may be applied to many other types of food processing equipment as well as other types of machinery on display at the Chemical Show.

One of the most important problems of food manufacture is the marketing and merchandising problem and in close co-ordination with these problems is the Container Section with some sixty exhibitors divided as follows: Fillilng machinery, 5; labelling machinery, 5; packaging and weighing machinery, 6; tanks, steel, 11; tanks, wood, 3; tanks and containers, miscellaneous, 8; barrels and drums, 4; bottling equipment, 6; metal and decorated cans, 2; cooperage, 3; bags, 3; fibre containers, 1; miscellaneous, 3.

Most of the exhibits in the Container Section will be of interest to food manufacturers but the close alliance between this section and the Food Processing Equipment section should be of sufficient importance in the marketing and merchandising of food products and food by-products to cause manufacturers to give careful attention to these sections.

The methods of handling food in these days have reached a high standard of efficiency and sanitary methods applied to the handling of foods have been largely due to the efforts of chemical engineering practices developed after careful study and application of the most modern and up-to-date appliances, practices, possible to-day. Yet the changes are so rapid that the various conditions of merchandising and marketing have been reduced to a scientific process for the manufacturer. Most of the modern appliances will be exhibited at the coming Chemical Exposition.

Interesting as these facts are, one of the outstanding features is that much of this equipment can be used in other industries. This applies to the plastics, chemicals, various paints, varnishes, shellacs, lacquers, drugs, perfumes, toilet preparations and various proprietary medicines.

The manufacturers of rubber products will find much that will be of importance to their particular problems on display in the way of machinery and equipment. The changes in this industry during the past quarter of a century have been one of the outstanding developments in the science of chemistry and chemical engineering, and the importance of such exhibits will draw many of the leaders in this field from both the executive and technical staffs of the rubber industry.

The Raw Materials Section with the mining exhibits will contain almost everything required in handling and processing the raw material from the time it is taken from the ground and passed through the process stages in manufacturing and treatment to the shipping of the finished product. The roster of exhibitors will give to mining men a list of the most distinguished makers of equipment whose machinery and processes are now used universally in the mining field.

Raw materials are of the utmost importance to all industry and the railroads pay particular attention to such resources located in the territory they serve and constantly endeavour to create new resources in the raw material field. It is because of this factor that the Chemical Exposition is of such importance to the Public Service Industries who use the Chemical Exposition as one great source of information on the latest developments in the various fields which they cover.

Records of past Expositions show an ever-increasing attendance of the engineer-

ing and executive staffs from the Public Service Industries which cover a great field and are large users of chemical equipment, machinery and general chemical practice in their various branches such as railroads, electric light and power, gas companies, disposal companies, and in addition numerous transportation companies including the marine organisations and refrigerating units.

Public Service Industries depend greatly on developments in the chemical industries and chemical engineers for new and modern practices and equipment for efficient and economic operation.

For the first time it is expected that the United States Military Academy at West Point will join with other colleges which take advantage of the opportunities presented by the intensive course of training on the Fundamentals of Chemical Engineering Practice as given in the Students' Course, which is an important feature of the Exposition.

The Course will be under the Chairmanship of Professor W. T. Read, Texas Technological College, Lubbock, Texas. Letters have already gone to the leading educational institutions inviting them to send classes or students. The programme and the subjects will be announced shortly with the names of the speakers who will deliver these lectures.

These courses are not confined to educational institutions but are open to any qualified applicant either in the advanced course or the elementary course. These courses are used as an Extension or Supplementary Course in Industrial Chemical Engineering.

The Management and the Committee give particular attention to the work of various students and reports are made to proper persons regarding such work by the Chairman in charge.

The Chemical Industries Banquet which has become an important function of Exposition Week will again be held on Thursday evening, May 9, under the auspices of some fifteen to twenty chemical and chemical industry associations and societies, directed by the Salesmen's Association of the American Chemical Industry.

ROYAL SOCIETY OF ARTS.

Friday, April 12, at 4.30 p.m.—Indian Section. A. T. Cooper, M.Inst.C.E.: "Recent Electrical Developments in India."

Monday, April 15, at 8 p.m.—(Cantor Lecture.) Sir E. Denison Ross, C.I.E., Ph.D., Director, School of Oriental Studies: "Nomadic Movements in Asia." (Lecture 1.)

Wednesday, April 17, at 8 p.m.—(Ordinary Meeting.) F. E. Lamplough: "Vita Glass."

THE PHYSICAL SOCIETY.

Guthrie Lecture.

It is now announced that the Fourteenth Guthrie Lecture will be given before the Physical Society by Professor P. W. Bridgman of Harvard University on "The Properties of the Elements under High Pressures." The lecture will be held at 5 o'clock on Friday, April 19, 1929, in the Imperial College of Science, Imperial Institute Road, South Kensington. Admission is free without ticket.

ZAGREB FAIR.

Chemical products are to be exhibited in the Zagreb Trade Fair, Yugoslavia, from September 7 to 16, when a full range of manufactures of all countries will be shown. The Spring Fair, which is being held from April 20 to 28, is confined to motor cars and cycles, agricultural machinery and gramophones. It is stated that 300,000 people visit the Zagreb Fairs each year.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

9,050. Adam, W. G., and Murdoch, D. G.—Production of sulphate of ammonia. March 20.

9,197.—Asiatic Petroleum Co., Ltd.—Production of motor spirit. March 21.

8,726.—Becker, A.—Washing cyanide compounds, etc. March 18.

9,360.—Distilleries des Deux-Sevres.—Manufacture of concentrated acetic acid. March 22.

9,286.—I. G. Farbenindustrie Akt.-Ges.—Synthesis of ammonia. March 22.

Specifications Published.

296,074.—Soc. des Usines Chimiques Rhone-Poulenc.—Process for the manufacture of potassium manganate.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

VANILLEX.

500,002.—Chemical substances for use in the manufacture of perfumery.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. March 27.

ANTI-JOCK.

500,026.—Chemical substances prepared for use in medicine and pharmacy.—Harold Stanley Murphy, 49, Maberley Road, Upper Norwood, London, S.E.19. March 27.

RAVITAN.

500,015.—Chemical substances prepared for use in medicine and pharmacy.—The Hoffman-La Roche Chemical Works, Ltd., The "Roche" Laboratories, 51, Bowes Road, London, N.13. March 27th.

HYDRIOL.

500,069.—Chemical substances prepared for use in medicine and pharmacy.—May & Baker, Ltd., Garden Wharf, Church Road, Battersea, London, S.W.11. March 27.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid
Specialities!
"CONTRACITE"
Compressed Cubes.
"KAUTSHIT" Cloth
A Perfect Resistant
for acids.
SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3601.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.

Printing Works: Hop 2404.

CONTENTS. PAGE.

Magnetism—Notes ... 241
By F. H. Loring.

Physical Constants ... 242

Radioactive Disintegration Theory ... 244

Dissolution of Silver in Water ... 244
By H. Krepelka and F. Toul.

Analysis of Photographic Emulsion ... 247
By S. Matsumaye.

Physico-Studies on Bioluminescence... 247
By S. Kanda.

Potential of the Nickel Electrode ... 248
By N. M. Haring and E. G. Vanden Bosche.

General Notes:—
- History of Fast Dyeing and Dyes... 248
- Mineral Production of Canada ... 251
- Canadian Water Power Resources... 251
- Blast Furnaces ... 251
- Coal, Iron, and Steel Output of France, U.S.A., Germany and Belgium ... 251
- British Shipping Movements ... 252
- Tenders in Greek Language ... 252
- New Capital Issues in March ... 252
- Portuguese Trade and Industry ... 252
- Indian Trade in January ... 252
- Newfoundland's Trade & Industries 252
- Ontario Government Offer for Research ... 253
- S.A. Association for the Advancement of Science ... 253

Proceedings & Notices of Societies:—
- Geological Society of London ... 253
- Society of Public Analysts ... 254

Notices of Books ... 255

Forthcoming Events ... 255

New Patents ... 255

Trade Marks ... 256

MAGNETISM-NOTES.

By F. H. LORING.

1.—In my article on Magnetism (*Chemical News*, this vol., pp. 161, 178) it will be seen that in the sketches shown at the conclusion (p. 180) I have adhered to the usual conventionality respecting the direction of the current relative to that of the magnetic lines of force. The electrons in current-bearing conductors move in a direction *opposite to that shown in* text-books as representing the direction of the current. This should be taken into account.

In Fig. 1 the vortex-pair is rolling up towards the observer, as based on the old convention; but this standard as just stated, is wrong, so correcting, the vortex-pair would roll away from the observer, *i.e.*, *down*; or, keeping the rolling the same way (towards the observer, *i.e.*, *up*) the magnetic lines joining the vortices would have to be reversed. According to Fig. 5, taken as a motor, this change makes it necessary to institute a further change in Fig. 1, by putting the positive matter on the other side of the vortex structure, but still in virtual contact with it. When this is done, the vortex-pair rolls down, its lines of force having been reversed as just stated, to meet what I will now call the new convention. In Fig. 5 the magnetic lines of force due to the current in the conductor have to be reversed, and the urge on the wire is towards the right-hand side of the page, the current being down for a motor. This is, of course, the true direction of the current. In Fig. 4 the vortex-pairs have to be considered as having slipped across to the next positive matter, so that it comes on the inside of each vortex-pair as shown by Fig. I. The drag of the field lines would favour this change over, while in the case of the motor the opposite urge would press the vortex-pair to the other side of the positive matter regarded as relatively fixed. In the dynamo case the current would be up when the circuit is completed. The letters N and S refer to the pole-pieces not drawn in, and the lines between them remain as they are, *i.e.*, they are not to be reversed. The rolling action, here described more in detail, may only be a convention, but it helps to form a picture of the process, without as yet attempting to take into account the transformation of energy involved in the process. The seat of this energy will be hinted at below.

2.—Another feature may be of interest. If the vortex-pairs, carrying the fan-line

structure (see Fig. 5, p. 180) are moving in the *same* direction as the current, the lines of force encircling a conductor might have a movement along it. Therefore, to generate a current by this movement of magnetic lines, a wire would have to be arranged at right angles to the lines, *i.e.*, radial from the conductor; but such a scheme is impossible in practice, as one cutting that produces an ⟶E.M.F. is neutralised elsewhere in the completed circuit by another cutting that produces an ⟵E.M.F., so that the voltage is always nil. One is here reminded of the famous Michelson-Morley experiment recently discussed in these pages—a different problem, however.

I have tried out on paper all manner of combinations of circuits, moving wires, moving mercury conductors with high-velocity small-sections, etc., but the result is (⟶E.M.F.)+(⟵E.M.F.)=0.

3.—From the foregoing one might at first expect that an iron disc, pivoted in its centre like a compass needle, would rotate if surrounded by a current-bearing coil of wire arranged in the same plane as that of the disc; but from dynamo experience, particularly homopolar machines, a field of this kind would not be expectede to put a drag on the armature; in other respects the pivoted disc would *not* rotate, if the magnetic lines move as above postulated.

4.—Again, putting a ring of iron round a current-bearing conductor would have no influence on the assumed longitudinally-moving lines, as any gain or loss at one point would probably be compensated for by an opposite effect at another, thus simulating the electromotive forces discussed above.

5.—It seems that all these considerations point to a most complete system of *equivalence imaginable*, so that the hypothesis of longitudinally-moving lines, while possibly useful in transmitting energy more or less exterior to the conductor, can never be demonstrated. In other words, the above electromotive forces in question appear to be a feature that cannot be proved. Therefore, to all intents and purposes, they cease to exist, and it is by inference equally accurate to say that the magnetic lines do not move longitudinally. Perhaps this is a useful demonstration of a principle in physics. There is a question of language involved, too, for to say that a given effect does not exist may only mean that we are unable to detect it.

6.—Another feature is brought to light by this study. The anchoring of the vortex-pairs to the positive parts of matter would seem to prevent electrons from being driven bodily to one side of a very wide current-bearing conductor when it is placed in a transverse magnetic field—see Hall-effect—at least not to any appreciable extent. The Hall-effect is, of course, a very feeble one.

7.—In connection with this subject I notice that F. Wolf (*Zeit. für Physik*, 1928, 52, 314) has tried to show that electrons are bi-polar, but without success.

8.—Just what would happen when vortex-pairs leave a conductor, as in a vacuum tube, is an interesting problem, but the hypothesis of vortex-pairs is not fully worked out. The electron is very much a mystery still.

9.—I may have a few more notes to add later on, meantime the reader will find the *spinning electron* of Uhelenbeck and Goudsmit, and others, of interest in relation to this subject. As an introductory survey, H. S. Allen in his THE QUANTUM AND ITS INTERPRETATION, 1928, chapter XVI, gives perhaps the best account of the spinning electron.

The paragraph at the close of my article on page 179, beginning " It will be seen . ." should be deleted, as I do not think that the observation is necessary in view of the triangular shape of the magnetic systems.

PHYSICAL CONSTANTS.

(*Continued from page 228.*)

Continuing this survey, it is of interest to note that when using Flamm's equation, $e/m.c \quad 2\pi^2 e^5 / R_\infty c h^3 = 1.76439. \ . \ . \times 10^7 \times c$, when $2\pi^2 = 19.7392088$,

$c \quad = 2.997964 \times 10^{10}$,

$R_\infty = 109737.\dot{8}\dot{7}$,

$h \quad = 6.55\dot{6} \times 10^{-27}$ and

$e \quad = 4.776 \times 10^{-10}$.

H. D. Babcock (*Phys Rev.*, 1929, 33, 268) revises his former spectroscopic selection-values for determining e/m having now established better criteria for selection, the result being :— " $e/m = (1.7606 \pm 0.0012) \times 10^7$ E.M.U./GRAM." This later paper is not given in the above issue of the *Physical Review*, only the abstract. Taking the greatest value allowable in this case it is 1.762. The difference between this value and the one by Flamm's equation above is only 0.002. See *Chemical News*, 1928, 136, 145, 165, for a discussion of e/m values including the previous work of Babcock. In

the very doubtful equation, giving π as 3.14159 when $e = 4.776 \times 10^{-10}$ (see page 228) there is this much to be said : it supports Babcock's value through Flamm's equation.

A. S. Eddington (*Proc. Roy. Soc.*, 1929, 122, 358) suggests that from physico-mathematical considerations $hc/2\pi e^2 = 136$, *i.e.*, a *whole number* of this value. Keeping to the above values for h and c (a being the usual multiplier),

$$hc/2\pi c^2 = 136.18 \text{ when } e = 4.793a$$
$$= 136.98 \text{ when } e = 4.779a$$
$$= 137.15 \text{ when } e = 4.776a.$$

If the value here in question should be 136 exactly, then π might possibly be larger as suggested by Dr. J. H. J. Poole in *Nature*, April 6, 1929; but, on the other hand ,if it should be 137 exactly, then π should possibly be smaller as would seem more probable. A difficulty arose in bringing about check agreements in calculations involving the constants here studied which led me to suggest as a possibility a lower value for π, *viz.*, 3.1394117, the equation being $\sqrt{\{\pi^2/[(R_\infty + \Delta_a \times 10^4)/R_\infty]\}} = \pi_a$; when $\Delta_a = 0.015251652$, as arising from

$10^{-28}/\Delta_a = 6.55\dot{6} \times 10^{-27}$, R_∞ being as given below Flamm's equation (see *Chemical News*, 1928, 136, 165, and reference therein). In this connection see equation for evaluating c, given in the first part of this survey. This value of π used in Eddington's equation above does not, however, yield the value 137 exactly, but 137.07 instead of 136.98. 4.779 gives the nearest value to a whole number, 137, when using the values of h and c I have adopted.

The argument therefore leads back to $4.779a$ being as good as any, while the π equation given in the first part of this study is very doubtful, yet Babcock's value supports the π-equation value in question, but this runs contrary to Eddington's views, but Eddington's whole number, 136, breaks down because h depends upon e as illustrated by approximate ratios in the first part of this article (p. 228). I am doubtful of whole numbers as exact integers, but prefer to think of a difference between an absolute whole number and the value approximating closely thereto, as the really significant feature. It may be the 136 and *something over* that is really important. In this case, perhaps 0.98; and this is near to unity, so that again there is a difference—of 0.02, and this may be more important still, and so on almost *ad infinitum*, until h is reached, the most important of all. It is not the flea that bites, but the flea that bites the flea, and the flea that bites that flea which sets the whole biting business going, so that the smallest flea is responsible for all the trouble, and in physics that is h. Jeans in his little book ATOMICITY AND QUANTA says much the same thing only in other words. Perhaps I have carried the idea further in respect of whole numbers.

NOTES.—It will be seen that I have used recurring, or repeating, decimals in two cases. This at first was the result of calculation, then followed a ' try on,' and the recurring decimals involve the principle of geometric progression as given in books on algebra. As the results came within the narrowed range of probability I have adhered to the recurring figures, but it is obvious that they are not accurately established in consequence. It is customary to round off a value to a nought or repeating noughts. I have adopted the plan of rounding off to recurring decimals so to speak whenever there seemed a tendency for the figures to repeat themselves. In other words, the benefit of the doubt is cast in favour of recurring figures whenever there seems a tendency in this direction.

Since writing the above I see that Babcock has published his paper in the *Astrophys. Journ.* for January, 1929, of vol. 69, p. 43. Babcock in his equation uses the air-velocity of light, which is 299704 kms. per sec., as the spectral lines were observed in air. Babcock refers to an agreement of his value with Houston's (*Phys. Rev.*, 1927, 30, 608), but from my recalculations with Aston's newer mass values Houston's results are different, as I have shown in these pages—See *Chem. News*, 1928, 136, 161.

It is important to note that when using equations with e/m as determined by *deflection methods* the resultant value may not be the true one, especially if it is otherwise a spectroscopically determined constant. It may be that the e/m value as determined spectroscopically by means of, say, the Zeeman effect, as in Babcock's case, can be used for fixing the constants but m is probably variable in this case; that is to say, it is larger owing to the relativity effect. It is interesting to make comparisons, however. Using π_a and 4.776 in Flamm's equation with c, h and R_∞ as under same, gives 1.762.

On page 229, 17th line from end, insert $\times$ sign in place of " = "; this is for the value of c being the *vacuum velocity*.

F. H. L.

(To be continued.)

RADIOACTIVE DISINTEGRATION A CHANCE PHENOMENON DEDUCIBLE BY MEANS OF THE NEW QUANTUM MECHANICS OF HEISENBERG AND SCHRODINGER.

R. W. Gurney and E. U. Condon in the *Physical Review* for February, 1929, vol. 33, p. 127, have propounded a theory of radioactivity as stated in the title above, while at about the same time Gamow (*Zeit. für Physik*, 1928, 51, 204) had advanced a similar basic theory, though Gurney and Condon had made a preliminary publication in *Nature* for September 22, 1928.

It appears from these investigations that the statistical nature of the quantum mechanics "gives directly disintegration as a chance phenomenon without any special hypothesis."

This theory makes its attack on the nucleus of the atom where radioactivity originates. The disintegration constant can be calculated and quantitative calculations of the Geiger-Nuttall relation giving an interpretation of the rate of disintegration and the energy of the emitted alpha-particle follow. It is the energy of the issuing alpha-particle which "determines its own rate of decay."

The *modus operandi* reduces mainly to a probability state which the new quantum mechanics treats with great elegance, and the nucleus disintegrates without absorbing external energy. The theory is not quite complete, however.

It is probable that three types of disintegration exist. The two first-named authors state—"There seems no reason why there should not be three types of disintegration: that in which the probability of escape is much greater for an alpha-particle than for an electron; that in which it is much greater for an electron than for an alpha-particle; and that in which the probabilities of escape are comparable. The last gives the branching type of disintegration as shown by RaC, of which 99.97 per cent. emits beta-particles, and 0.03 per cent. alpha-particles."

The original should be consulted for working details. The theory is largely mathematical. The new quantum mechanics is fast becoming a powerful mathematical tool for the analysis of obscure phenomena. What the ultimate outcome of the great activity in this field will be it is impossible to say. It is to be hoped that it will yield something which can be properly understood.

F. H. L.

THE DISSOLUTION OF SILVER IN WATER.*

By H. Krepelka and F. Toul.

In biochemical literature there are some reports concerning the olygodynamical influences of metallic silver which are due to its effects upon bacterial cultures. For instance, Masung (*Zentral-Blatt für Bakteriologie und Parasitenkrankheiten*, 1918, I. Abt. 82 (311-317) proved with glinea pigs apparent prolongation of infection and even its complete paralysis if the injection was made both with bacteria and a little metallic silver. R. Doerr (*Biochem. Z.*, 1920, CVI, 110-133) studied these phenomena somewhat more minutely. As a biochemist he made experiments with water which was for a considerable time in contact with silver and proved that this water had an olygodynamical effect. On distillation this phenomenon ceased. Likewise a solution of sodium chloride lowered its bactericidal power but on the other hand reducing agents were without effect. The same author studied in his other paper (*Biochem. Z.*, 1920, CVII, 207-213) water in which silver previously heated in the air was boiled for a considerable time and he observed an increased olygodynamical effect. In his further experiments (*Biochem. Z.*, 1921, CXIII, 58) he makes use of silver previously brought to a white heat and afterwards dipped in paraffin oil. This not quite suitably reduced silver behaved in the same manner as the unreduced metal. In the conclusion of his papers (*Biochem. Z.*, 1923, CXXXI, 551-617) Doerr summarises the whole study and forms the opinion that silver acts olygodynamically as $Ag^{\cdot}$. He cites a brief note of the German chemists Hönigschmid and Birckenbach (*Ber.*, 1921, LIV, 1888) from their paper, "Revision of the atomic weight of bismuth." In this work the authors, when analysing the bismuth chloride, used water distilled from a silver cooler and proved that, on this occasion, the water thus prepared contained $Ag^{\cdot}$ to the amount of 0.04-0.06 mgrs in 1000 ccs. Without studing this fact more minutely they explained the amount as coming from a laboratory atmosphere.

*Presented before the Czech Academy of Arts and Science, February 20; abstracted from *Collection of Czechoslovak Chemical Communications*, March, 1929.)

This explanation is inadequate and shows that when investigators have employed silver vessels or coolers the solubility of silver in water has here and there been disregarded.

The cited papers dealing only with the olygodynamical effect of water which has been in contact with silver for a considerable time do not solve the problem of the actual dissolution of metallic silver in water. The olygodynamical effect described may be explained not only from the presence of $Ag^{\cdot}$ in the solution, but also from silver in a state of colloidal suspension; for this reason sodium chloride lowered the bactericidal effect (by the coagulation of $AgCl$), while reducing agents were without effect. Besides this Matsung and Doerr did not take sufficient care for the purity of water used in their experiments, nor for the influence of the laboratory atmosphere, temperature, light, the presence of alkalies, the glass and, not the least, the purity of the silver. The remark of Hönigschmid and Birckenbach concerns the action of water vapour mixed with the air of the laboratory upon the silver cooler. This action of water vapour must evidently be more powerful than that of water at ordinary temperatures. Therefore the figures derived from that action upon silver cannot hold generally and must be regarded as correction factors true only for the special case of the work above-mentioned authors.

In order to solve the problem generally we have used for our experiments the silver of standard purity which has been prepared by Krepelka (*J. Amer. Chem. Soc.*, 1920, XLII, 926), alone for atomic weight work, and also the water of standard purity thus excluding the influences mentioned above.

The distilled water of the laboratory, previously freed from organic matter by the action of potassium permanganate in sunlight was twice distilled for every experiment, first from a vessel made of hard Bohemian glass and through a cooler of the same material and then through a platinum cooler directly into the bottles of hard glass, furnished with double glass stoppers.

The silver, the preparation of which is described in detail in the above-mentioned paper of Krepelka, was melted again on pure calcium oxide in an atmosphere of dry and pure hydrogen. The surface of the pieces of silver was etched with nitric acid, water, ammonia, and then thoroughly washed again with water. After this the silver was dried in an electric over at a temperature of 110° C. In order that its surface should be as large as possible the pieces rolled into thin leaves between steel rollers, previously well cleaned with alcohol and ether. After every turn of the rollers the surface of the silver was etched anew.

In the preliminary experiments thick walled Erlenmeyer vessels were used. The silver leaves were brought into contact with freshly distilled water, which contained only traces of absorbed gases (air, carbon dioxide). The vessel was filled to the top and its glass stopper coated with paraffin in order to exclude the outside air. The vessel, thus filled, was kept in the dark at temperatures of 18-20° C.; at times its contents shaken. After a definite time the water from the vessel was poured into a large quartz dish and very carefully evaporated in the dark to a volume of 60-80 ccs. After this volume was reached the water was quantitatively poured into a glass measure and its amount increased to 100 cc. The solution thus diluted was nephelometrically tested and compared with a known standard of $Ag^{\cdot}$, the concentration of which was chosen in such a manner that it was very near to that of the solution tested. The results are given in Table I.

TABLE I.

Time of contact of silver with water in days		Silver 1000 ccs.
7	...	0.012 mg.
14	...	0.021 ,,
21	...	0.035 ,,
180	...	0.036 ,,

From the figures quoted it is clear that silver under the conditions of the experiments passes into the solution and that its amount depends upon the time of its contact with water. The equilibrium (saturation) is reached after an interval of about 21 days. It is to be emphasised that the figures obtained are very near to those quoted by Hönigschmid and Birkenbach (0.04-0.06) but evidently a little lower. The water used, as mentioned above, could have been contaminated with traces of absorbed air, the silver on its surface could have absorbed traces of hydrogen, air or have been covered with a very thin coating of oxide.

From these preliminary results of nephelometric measurements it follows that silver in contact with water passes into it either in a state of colloidal suspension, which is exidised by the absorbed oxygen into silver oxide, relatively easily soluble in water, or directly in the form of $Ag^{\cdot}$.

It is evident that silver passes into the solution in the form of $Ag^{\cdot}$. It is to be emphasised that on recalculation of the figure C which gives the normality of the solution we obtain 0.01 mg. in 1000 ccs., which agrees quite well with the results obtained by nephelometric measurements.

The dissolution of silver in this form may be caused, as mentioned above, either by direct passage of it into the water solution (atomic solubilityz) or may be regarded as a result of a primary oxidation of its surface. Under the condition of the experiment this solubility might be caused, or at least increased, by alkalies dissolved from the glass.

In order to study the effect of this factor, all further work was carried out in silver vessels only. These were previously cleaned with dilute nitric acid, ammonia and water and after this rinsed for a considerable time with water vapour. For these experiments the silver, in a powdered form as obtained on reduction of its ammoniacal solution with sulphur dioxide, was used.

The inner surface of the silver vessels and the silver powder were first of all freed from the traces of oxide or oxygen. The water, freshly distilled, was boiled and whilst boiling poured into the silver vessels which were filled with pure hydrogen. In an atmosphere of the same gas the water was then cooled to laboratory temperature. After cooling the vessels were closed with well ground silver stoppers and in order to exclude the oxygen of the atmosphere the necks of the bottles with stoppers were thoroughly coated with paraffin. All the vessels were shaken during 7, 14, and 21 days. After this period they were opened, the water quickly poured out, filtered and evaporated on a quartz dish in a pure atmosphere in the dark room. After evaporation to a convenient volume the water was poured quantitatively into a glass measure and then tested nephelometrically. For these measurements potassium bromide solution was used as a nephelometric standard.

Nephelometric tests show clearly that the silver surface which was previously cleaned with hydrogen does not dissolve in the water freed from oxygen and carbon dioxide, at least not in an amount which could be detected by nephelometric test.

The amount of alkalies and its influence upon the solubility of silver was studied in the following manner. The water used for the experiments was tested by means of conductivity measurements both immediately after distillation and after having been in contact with the glass surface of the vessel in which the experiments with silver were made. The water was directly distilled into the vessel in which the silver had been shaken. The air which passed through the water was freed from its carbon dioxide by means of a series of tubes filled with soda lime.

The conductivity was measured at definite intervals so that the water was refilled into the conductivity vessel by means of a syphon. The carbon dioxide in the vessel was removed by suction through a system of tubes filled with soda lime.

The platinised platinum electrodes were very carefully prepared, their occlusion of gases was removed by repeated washing until several successive measurements afforded quite coincident results. After that the conductivity constant of the vessel was ascertained and found to be 9.537.

The initial decrease of conductivity is caused by continual reduction of the amount of carbon dioxide, after 39 hours the conductivity was constant for a considerable time. After 168 hours it increased slightly although the influence of carbon dioxide is quantitatively excluded. The increase is caused by alkalies dissolved from the glass, which also have an influence upon the solubility of silver.

SUMMARY.

1. Pure silver in contact with distilled water dissolves and passes into the solution in the form of $Ag^{\cdot}$. By nephelometric measurements 0.01-0.087 mg. in 1000 cc. were obtained.

2. The lowest figure 0.01 mg. was obtained after 7 days' contact of silver with water in a glass vessel. This figure agrees quite well with that derived from the measurements of the potential of silver in water.

3. The highest figure 0.087 mg. in 1000 cc. was reached as a rule in 21 days. Since prolonged contact did not have any influence upon the increase of concentration of $Ag^{\cdot}$ in solution, this figure may be regarded as the maximum amount of silver dissolved under the above-mentioned conditions.

4. The silver, the surface of which had been previously reduced by pure dry hydrogen at 400° C., did not dissolve in water which was freed from atmospheric gases and carbon dioxide. The nephelometric test of such a water was always negative.

5. From the investigation carried out it follows that the dissolution of silver is caused by its surface oxide, or by oxygen

absorbed on its surface or by oxygen dissolved in water.

6. The results of the measurements of the solubility made in glass vessels are on an average higher by 0.008 mg. than those obtained from silver vessels. This difference is very probably due to the influence of alkalies dissolved from the glass.

The Institute of Inorganic Chemistry,
Charles' University, Prague,
Czechoslovakia.

PHYSICO-CHEMICAL STUDIES ON BIOLUMINESCENCE. — VII. THE SOLUBILITY OF CYPRIDINA LUCIFERIN IN ORGANIC SOLVENTS.

By Sakyo Kanda.

(Scientific Paper of the Institute of Physical and Chemical Research, Japan.)

Introduction.

As is already known, the luciferin of Cypridina hilgendorfii is soluble in absolute methanol, ethyl and propyl alcohols. In other organic solvents such as acetone, benzene, chloroform, ether, petroleum benzine and petroleum ether, the luciferin is insoluble. This insolubility of luciferin in these solvents makes it very effectve in a thorough extraction of the fat or fats of dried animals.

These fats, however, are quite puzzling, because the luciferin, par excellence, becomes soluble in benzene, chloroform, ether, etc., after it has been isolated with methanol and ethyl alcohol. This peculiarity of luciferin was not entirely known until quite recently. Experiments are still in progress. But the present paper will deal with new facts hitherto found in the solubility relations of luciferin, which will throw some light on the chemical nature of Cypridina luciferin.

Preparation of the Material.

The "*shells*" of about 570 g. of the dried Cypridinas were crushed and were carefully sifted off as usual. The fat or fats of about 180 g. of the body parts were thoroughly extracted with a great many changes of petroleum ether in the course of 81 days, then with ether during 37 days and lastly with benzene for 35 days. During 153 days (July 10 and Dec. 10), the solubility of luciferin was in no way detected in any of the solvents, that is to say, in petroleum, ether, or benzene. The evidence seems to indicate that the luciferin is insoluble in these solvents. The truth, however, is quite the contrary. These points will be made clear at the proper places.

Although some diminution of luciferin was noticeable after extraction of the last trace of the fatty substances of the body parts with benzene, these still contained intact a large quantity of luciferin. The luciferin may be readily isolated as follows.

Isolation With Methanol.

The fat-free body parts pulverised in a mortar (on Dec. 10) and extracted with about 300 c.c. of absolute methanol for 24 hours were filtered off twice with a heavy filter paper. The filtrate was perfectly clear and was red in colour. Yet the ultramicroscopic examination proved it to be a colloidal solution with abundant small particles. It contained a very large quantity of luciferin, as a few drops of it produced a brilliant light, if Cypridina luciferase was added. It also contained a protein or protein derivatives, because it gave Millon and ninhydrin reactions. But the colloidal particles and the protein colour reactions are not due to the presence of luciferin but to something else will be shown later.

The residue was thoroughly washed many times with about 600 c.c. of pure methanol until the presence of luciferin was not detected any more in the washed out methanol solution. The washed out methanol solution was carefully filtered twice with a heavy filter paper and the filtrate was perfectly clear. It also contained a large amount of luciferin, as it gave a brilliant light if luciferase was present.

Both the filtrates poured into a suction flask, which was connected with a water pump and was also connected with a capillary tube through which pure H_2 was passed, were evaporated down to about 30 c.c. of syrup on the water bath at 38-40° C. The luciferin of course remained intact in the residue.

Isolation With Ethyl Alcohol.

The residue prepared with methanol was poured into a large beaker and about 600 c.c. of absolute ethyl alcohol were added to it. It gave a voluminous precipitate. It settled on the bottom of the beaker for about 10 minutes. The supernatant fluid was carefully filtered off with a heavy filter paper and was kept for further experiments. The precipitate was thoroughly washed with absolute ethyl alcohol on the filter and was incompletely dissolved in redistilled water saturated with H_2. This solution contained some protein or protein derivatives, as it still gave Millon and ninhydrin reactions, but no luciferin.

On the other hand, the supernatant fluid which was carefully filtered off contained a very large quantity of luciferin, as it gave a brilliant light if mixed with Cypridina luciferase. It also contained a protein or protein derivatives because it still gave Millon an dninhydrin reactions. Although the fluid was perfectly clear, it showed abundant colloidal particles under the ultramicroscope.

This clear fluid was also evaporated down to about 30 c.c. of syrup in the same way as in the case of methanol. The evaporation of ethyl alcohol was very slow. It took many hours and was continued till even the next day. Nevertheless the luciferin was found unharmed in the residue.

(To be continued.)

THE POTENTIAL OF THE NICKEL ELECTRODE.

By N. M. Haring and E. G. Vanden Bosche.

(Abstracted from *J. Phys. Chem.*, 1929, p. 161-178.)

In view of the importance of nickel from the standpoint of the electro-plating and electro-forming industries, a systematic investigation has been made of the standard potential of the nickel electrode. The literature of the subject shows values varying from -0.188 to -0.621 v., calculated against the standard hydrogen electrode as zero. A number of these determinations are based on work carried out without adequate regard to the importance of temperature control, purity of materials, oxygen-free conditions, etc., factors which have been carefully controlled by the present authors. The samples reported in this paper are based on determinations made on samples of nickel obtained from five different sources and the conclusions are as follows :—

The standard potential of nickel is found to be -0.231 v. ± 0.002 v. at 25° C. (77° F.).

Nickel prepared by electrolysis at high current densities is most satisfactory for measurements of electrode potential.

The necessity for excluding oxygen and hydrogen during potential measurements has been re-emphasised.

Nickel chloride, due to hydrolysis, has been found to be an unsatisfactory electrolyte for measurements of potential.

It is impossible in a short abstract of this kind to do justice to the paper and the reader should consult the original.

GENERAL NOTES.

HISTORY OF THE DEVELOPMENT OF FAST DYEING AND DYES.

By James Morton.

Paper read before the Royal Society of Arts, February 20.

(Continued from page 235.)

But what about our autoclaving? The above incident was in early March. It was impossible to wait further months for we were starving for colour. So we thought, why not try weldless steel tubing, and we learned that a length might be available at Cochran's Boiler Works at Annan. I can remember the very cold night we drove out to Annan on that quest, the keenness and determination of each of us, and we brought back in our car the tubing which occurs in my notes under date just three weeks after the rebuff incident recorded above, as follows :—

"Saturday, March 27 ,1915.—Have had first satisfactory results silver salt into 2-amino-anthraquinone from improvised autoclave made out of Stewart and Lloyd M.S. Tubing 3ft. 8in. long by 10in. diameter. Charge 7 gallons silver salt and ammonia, gave us sufficient amino for 20 lbs. of colour. Immediately put two other vessels in hand, which should give us 60 lbs. per day, sufficient to dye 25 to 30 pieces cloth of a medium blue or green."

It was one of the red-letter days, and though the colour was by no means "standard," it was the first real works Blue and Yellow Vats produced in this country, made, as you see, at the works in Carlisle, and from plant practically all local. It was, as I have said, the real beginning for from that day we have never ceased getting our supplies from our own production. And it will give some idea of the growth from that small beginning when I tell you that of these two colours, or their variations, our plant has now a capacity of over 10 tons a week, or about 1 million libs. a year.

By October of that year — 1915 — a thoroughly sound 8 cwt. autoclave, with stirring gear and everything complete, had come to the assistance of our little battery of tubing autoclaves. This was cast by Edgar Allen of Sheffield, and proved sound in every way. It was succeeded by one of a ton capacity, also made by the same firm, and later, by some from Hadfield of Sheffield, and others, most of which are still running.

I have given you the history of these autoclaves in some detail because they form one of the chief keys in the manufacture of Vat dyes, and because they represented a problem in high pressure and high temperature reactions that was quite new to the chemical and engineering experiences of this country, and that demanded a combined skill and knowledge of the highest order.

But fresh obstacles had in the meantime been developing towards an easy road to our dyes production. As I have told you, we began by getting our silver salt ready made, but it was soon apparent that this source would not be available. This meant that we had to tackle the whole problem of the manufacture of these long process dyestuffs, not only from the silver salt forward to the finished dyestuffs, but from the crude coal tar anthracene right through its stages to the silver salts. The chemists among you will realise something of what was involved. Commercial anthracene could be had of 40 per cent. purity only. This had to be purified up to 95 per cent. at two stages. It had then to be further sub-divided by sublimation with super-heated steam, which again had to be converted into crude anthraquinone and this developed up to a purity of 95 per cent. before it could be ultimately sulphonated with oleum into the desired silver salt.

Such was roughly the further road we had to travel for lack of our supply of ready-made silver salt. It was a road with obstacles enough to scare amateurs in ordinary times, and when one thinks of the conditions then existing one wonders how we ever started or ever got through. For it was just then that it was being realised how long and tough the struggle of War might be. Every man and every human activity were claimed for the services of the War. And not only men, but materials, for can one forget the difficulty with which we could be spared a few pounds of lead or a few hundredweights of steel, or how we felt it almost criminal to ask for any purely business purpose the smallest extra supply of sulphuric acid, oleum or glycerine? I recall these facts now not only to give you younger people some idea of the tense conditions of those times, but because criticism has sometimes been lodged against British dye-makers that they were not more advanced in their problems and production by 1918. Such criticism is apt to forget that not only were we all personally mainly engaged on other work essential to the War, but the very elements that go to the making of dyes were scarcely procurable.

But by dint of many varied efforts we got our new buildings and plant erected, on a smal lscale first, and later in much bigger form, so that we were ultimately equipped for the making of these anthraquinone colours from the coal tar to the intermediates and the finished dyestuff. And having had to extend our operations to this broader field, we naturally investigated as to what other colours we should tackle to justify this comparatively large chemical plant. Our chemical reader at the Patents Library had been kept very busy, and had supplied us with the necessary data for our own group of Vat dyestuffs, and in the meantime we had got around us several young men of chemical training, so that research was going ahead now in our own laboratories.

Much of our attention at that time was concentrated on colouring matters dependent on the initial production of benzanthrone and the working up of this to a high state of purity was one of the problems that engaged much of the attention of our chemists over a long period. The highly successful results of this work was of far-reaching importance in the later stages of our development, as pure benzanthrone became a very essential factor in the manufacture of new colours which will be referred to later.

Apart from these Vat colours for our cotton trade, one of the dyestuffs that lay nearest to our path, and one that we knew would be of great use to the trade of the country was what had been known as "Alizarine Sapphirole," one of the sulphonated-amino-anthraquinones, containing Hydroxyl groups. This came in for early investigation, and by March, 1916, we had produced it in small quantities, while by the summer of that year we were making it for use in our own carpet dyehouse, and had sold little lots quietly to our carpet friends, who prized it mightily. It is the fastest of the acid wool colours, and was looked upon as the key colour in blues for wool. Indeed, if it had been permitted to import one dyestuff during the War, and if there had been a census among wool dyers, the vote would have gone overwhelmingly in favour of Alizarine Sapphirole. To give you some idea of the value of this colour, and the great loss felt by its absence, I think it worth while giving you a statement from important persons in the trade, which will speak for itself. On November 28, 1916, Mr. Sutcliffe Smith, a Director of the Bradford

Dyers Association, and for some years now Chairman of the Colour Users' Association, wrote an urgent letter to Mr., afterwards Sir Milton Sharp, Chairman of that company, urging him to do all in his power to stimulate the production of Alizarine Sapphirole by some firm in this country, and in order to show its extreme importance he proceeds :—

"During the first six months of this year we dyed for this trade 55,872 pieces. The average value of these pieces amounts to £14 per piece making a cash turnover value or £792,208 for the six months.

"On account of our inability to obtain Sapphirole, our output has been so seriously curtailed that had we been able to secure this dyeware we could, with the same men working the same number of hours, have turned out 83,808 pieces as against 55,872, and the value of goods passing through our hands would have been increased to £1,173,312, or to sum up, goods to the extent of a further £762,208 would have been treated in a year. No effort should be spared to produce this dyestuff as I cannot overestimate its importance to the whole of the textile trade, and its production will not only re-habilitate British reputation, but will be a distinct step in advance and a serious attempt to strike at Germany's supremacy."

So much for the importance and value of this dyestuff to one firm, and that was typical of the whole woollen and carpet trade over the country. This letter was written on November 23, 1916, and was quite unknown to me at the time. We had been making the colour, using it ourselves, and supplying it to a few friends in the trade, as you have been told, for six months previously.

But as I must explain at this point, we had given no publicity of any kind to our dye-making activities. We were using our production mostly for our own trade, and so had no occasion to advertise these activities or whatever achievements we might be said to have accomplished. On November 28 of that year, 1916, there appeared a very triumphant advertisement in the morning papers from a large Dye Company under the heading "A British Dyestuff—Indanthrene Blue," and claiming that whereas German chemists had prophesied that no British firm would produce this Vat dyestuff within ten years, they had now accomplished that feat. In spite of my native modesty I thought it only fair to our chemists and to the situation generally to let it be known that this feat of the big Dyes Company did not represent the high-water mark of British achievement—that we had been making that colour and others of the same series for over eighteen months, and that many thousand yards dyed by these colours had already gone from our works to all parts of the world.

This letter of mine to the public press had the effect of bringing many enquiries from users, and among them one from the Bradford Dyers Association, who had learned that besides Vat Colours we were actually producing Alizarine Sapphirole which, as I have shown, they were so much hungering after. It led to an immediate meeting between the Directors of that Company and myself and much useful collaboration afterwards. They had delivery of the Sapphirole—which we called "Solway Blue"—within a few weeks of our meeting, as well as of some of the Vat colours, and they have not ceased to get them in increasing quantities and varieties from that day to this.

I want here, if I may, to put on record the great stimulus given to our effort by the Directors of that Company, especially by their late Chairman, Sir Milton Sharp, who both in private and public was so frankly generous in his appreciation of our efforts. It was a great help and stimulus at a difficult time. And these things are not forgotten.

As I have said, that little bit of almost compulsory publicity brought us enquiries for colours from users all over the country, and we had to multiply the production as quickly as the conditions would allow. Of that most indispensable blue colour we were making by 1918 half the total prewar imports, and by 1919, 50 per cent. more than the total imports, while to-day our production is several times the total pre-war imports, and the colour is also made now by other firms in this country.

This was, perhaps, one of the chief services we rendered to the general trade of the country at that time, and I think users were agreeably astonished at the moderation of our price—I sometimes think now that had they been dealing with a Scotchman from Aberdeen instead of one only from Ayrshire, they might have been asked to pay a somewhat different figure for a commodity so invaluable at the time—one of those little facts of which one likes to remind the users in our controversies to-day!

(To be continued.)

THE MINERAL PRODUCTION OF CANADA, 1928.

Estimates Largely Exceeded.

The Dominion Bureau of Statistics at Ottawa has just issued its preliminary report on the mineral production of Canada during the year 1928, copies of which may be obtained on application to the High Commissioner for Canada, the Canadian Building, Trafalgar Square, London, S.W.1. The Bureau now estimates the value of the output to be $273,446,864, thus slightly exceeding the official year-end estimate of $271,000,000 and exceeding the 1927 figure by $26,090,169, or nearly 10.5 per cent.

Pointing out that the new mineral records set up in 1926 and 1927 were splendidly surpassed in 1928, the Bureau remarks that in few previous years has Canada's mining industry shown such phenomenal growth with advances general in all fields—metals, nonmetals, fuels and structural materials. The mining industry, it is stated, represents a capital investment of more than 700 millions of dollars and nearly 85,000 men are employed in the operating mines and their assosiated enterprises, exclusive of prospecting and outside development workers, of whom no record is kept.

Metallics.

Outstanding in the Report are the gains of 44 per cent. in copper production and 45 per cent. in nickel. Copper registered a gain of 6 6per cent. in value of production, the output of 201,940,172 pounds, worth $28,488,118 in 1928 comparing with 140,147,440 pounds valued at £17,195,487 in 1927. Nickel production amounted to 96,755,578 pounds worth $22,318,907 compared with 66,798,717 pounds valued at $15,262,171 in the previous year.

Gold still continues to hold its place as Canada's most valuable metallic, production of 1,891,050 ounces worth $39,091,472, representing a gain of 2.1 per cent. over 1927. Silver output was lower by 3.6 per cent and the value by 0.5 per cent., production being 21,922,795 ounces, worth $12,753,806.

CANADIAN WATER POWER RESOURCES.

The Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has issued its annual review of the water-power resources of Canada, developed and undeveloped, as at 15 January, 1929, according to the most recent information available.

The total water-power resources of the Dominion are now estimated to be 20,197,000 horse-power under conditions of ordinary minimum flow, or 33,113,200 h.p. ordinarily available for six months of the year, while the total hydraulic development at the present time amounts to 5,349,232 h.p.

The bulletin contains estimates of the developed and undeveloped power in each Province, and describes the use of power in the central station and pulp and paper industries, the past growth of utilisation, capital invested in water-power.

BLAST FURNACES.

From the available information as to furnaces in blast, it appears that the average output of pig iron per furnace in anuary was 4.160 tons in the United Kingdom, 5,740 tons in France, 6,160 tons in Belgium, 10,910 tons in Germany and 17,080 tons in the United States.

COAL, IRON AND STEEL OUTPUT.

France.

The January coal output was somewhat above that of January, 1928. The pig iron output, with an increase of 11.9 per cent. over January, was the greatest monthly total recorded; the quantity per calendar day averaged 28,720 tons, as compared with 27,990 tons and 25,680 tons in December and January, 1928, respectively. Furnaces in blast at the end of January numbered 157, a net increase of four since the beginning of the month. The production of crude steel was greater than in any previous month except October and December, 1928.

United States.

The coal production for January (52,494,000 tons) included 45,948,000 tons of bituminous and 6,551,000 tons of anthracite coal. With the exception of the October, 1928, output (52,602,000 tons), the January aggregate was the highest since March, 1927. Outputs between March, 1927, and September, 1928, were affected by the dispute in the United States coal industry. The production of bituminous coal averaged 1,808,000 tons per working day in January, 1929, compared with 1,569,000 tons in the previous month. The output of anthracite in January was somewhat below the monthly average for the fourth quarter of 1928, and averaged 252,000 tons per working day in January compared with 222,000 tons in December and 208,000 tons in January, 1928.

GERMANY.

The January coal output was the highest since March, 1926, and 68,640 tons more than in January, 1928. The January outputs of both pig-iron and crude steel show recovery from the falling off caused by the labour dispute in November. The make of pig-iron was lower than that for the previous January, but higher than in any month since March last. Output per calendar day averaged 34,850 tons in January, 1929, 32,240 tons in October, 1928, and 37,470 tons in January, 1928. Furnaces in blast at the end of January numbered 97, a net reduction of four compared with the beginning of the month, and of 19 compared with the end of January, 1928. The January pig-iron output included 183,900 tons of foundry and hematite, 685,440 tons of basic, 206,140 tons of ferro-alloys, and 4,850 tons of other descriptions of pig-iron.

BELGIUM.

The aggregate coal output for January, 1929, was exceeded last year only in March. The output per working day was about the same as a year previous, the respective figures for January, 1929, December, 1928, and January, 1928, being 92,840 tons, 92,680 tons and 92,850 tons. The January make of pig iron was higher than that of any month last year and compared with January, 1928, an increase of 11.5 per cent. was shown. Output per calendar day in January, 1929, averaged 11,180 tons compared with 10,960 tons in December and 9,980 tons in anuary, 1928. Furnaces in blast numbered 56 both at the beginning and end of January.

BRITISH SHIPPING MOVEMENTS IN 1928.

Our annual review of the movement of shipping at United Kingdom ports shows increases for last year as compared with 1927 in the foreign trade, except in entrances with cargoes. The British proportion of the total tonnage was over 1¾ per cent. larger. The coasting trade increased by almost 2½ per cent., vessels with cargoes marking an advance of more than 3¾ per cent.

TENDERS IN GREEK LANGUAGE.

The British Commercial Secretary at Athens has forwarded translation of a Circular, No. 86,400, of 15 February last, signed by the Minister of War. This Circular, which has been addressed to all the Legations in Athens, requests that it should be made known generally that offers and tenders in adjudications should be made out in the Greek language in order to facilitate the examining Commissions at that Ministry, except in very special circumstances, when the offers should be in French.

British firms interested can consult the translation referred to on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

NEW CAPITAL ISSUES IN MARCH.

Statistics compiled by the Midland Bank show issues of new capital in the United Kingdom during the first quarter of the year to have totalled £114.2 millions, as compared with £103.4 millions in the March quarter of 1928. This is the largest sum since the first quarter of 19 20, when the total reached £147 millions, but is not greatly in excess of the £112.9 millions of December quarter, 1927.

PORTUGUESE TRADE & INDUSTRY.

Last year was a difficult one for Portuguese trade and industry, although it was not without its encouraging features, writes Mr. A. H. W. King, British Consul at Lisbon. The United Kingdom has maintained her lead in the import trade during recent years, but in some lines, notably textiles and heavy goods, severe competition has now to be met.

INDIAN TRADE IN JANUARY.

There was an increase in the value of both imports and exports during January as compared with the first month of 1928. The United Kingdom's proportion of the import trade fell, however, to 41 per cent. from 48 per cent., and her share of the exports declined to 20 per cent., from 24 per cent. of the total.

NEWFOUNDLAND'S TRADE AND INDUSTRIES.

Last year was satisfactory for Newfoundlan trade owing to the good markets found for fish, and exports of merchandise considerably exceeded imports in value. Mining and manufacturing industries reported encouraging progress.

AGES OF BRITISH MIGRANTS.

A survey of the ages of British migrants between Great Britain and Northern Ireland and non-European countries last year shows that about 49 per cent. of the male and 39 per cent. of the female emigrants from Great Britain and Northern Ireland were between 18 and 30 years of age.

ONTARIO GOVERNMENT INCREASES OFFER FOR INDUSTRIAL RESEARCH.

In conformity with the Prime Minister of Ontario's "dollar for dollar" plan of assistance for industrial research in Ontario, a Bill has been introduced in the Legislature increasing the contribution of the Province to the Ontario Industrial Research Foundation from $1,000,000, as provided in the 1928 Act, to $2,500,000.

SOUTH AFRICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Located at Johannesburg, the Association has members in various parts of the Union, and correspondents and connections in various parts of the world. It has an extensive periodical and book library, most of the chemical and other scientific publications of the world being filed for the benefit of the members. Besides these and several other useful activities it publishes the *South African Journal of Science*, containing copies of papers and lectures, a full report of the year's activities of the Association, and other interesting information.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY OF LONDON.

Proceedings on March 20, Professor E. Garwood, Vice-President, in the chair.

The Chairman announced that the Council had this year awarded the Proceeds of the Daniel-Pidgeon Trust Fund to John Selwyn Turner, B.Sc., F.G.S., who proposes to undertake research on the faunal succession in the Coomhoola Grits and Carboniferous slate of County Cork (Ireland).

The Chairman further announced that the late Dr. C. S. Du Riche Preller, M.A., F.R.S.E., F.G.S., had left by will the sum of £100, free of all duties to the Society, *in memoriam*.

The following communications were read:

Some South Australian Algal Limestones in Process of Formation. By Sir Douglas Mawson, O.B.E., B.E., D.Sc., F.R.S., F.G.S.

This contribution serves to record three different types of limestone now actually in process of formation, under the influence of plant-growth occurring in the south-eastern region of South Australia.

The locality is but slightly raised above sea-level and quite flat, but for a series of old vegetated calcareous sand-dunes which extend in parallel formation across the country, thus interfering with the drainage and determining low swampy intervening areas. It is an area of almost horizontal late Tertiary limestone.

A remarkable development of limestone-'biscuits' occurs at 'Biscuit Flat,' a locality which is inundated in winter, but dries out in summer. The deposition of the calcium carbonate producing these forms is determined by the activities of blue-green algæ.

At a point near the coast, but isolated from the sea, are permanently inundated areas forming lakes of greater or less salinity. In Lake Karatta, one of these, an exuberant growth of algæ occurs, among which forms of *Lithothamnion* are conspicuous. Feedeing upon the algæ are abundant shrimp-like crustaceans. A veritable reef of algal limestone is building out into the lake, comparable on a small scale with a fringing coral-reef.

Lakelets recently cut off from the Coorong, an arm of the sea, which usually dry up more or less completely during the summer months, are floored with a thick deposit of what is known locall yas 'pipe-clay.' This proved to be a fine pulverulent deposit of calcium carbonate, somewhat dolomitized, evidently deposited from the saturated waters of the lakes during the spring season by the concentrating process of evaporation abetted by the presence of minute blue-green algæ.

The Unroofing of the Dartmoor Granite, and an Outline of the Distribution of its Detritus in the Sediments of Southern England. By Arthur W. Groves, Ph.D., M.Sc., D.I.C. (Communicated by Prof. W. W. Watts, Sc.D., F.R.S., F.G.S. Read by Dr. A. Brammall, M.Sc., D.I.C., F.G.S.)

A systematic outline mineralogical survey has been made of the sediments of Southern England, from the base of the Permian in Devon (Watcombe Clay) up to the Lenham Beds of the North Downs, in search of detrital minerals of the Dartmoor Granite. The work is based on the very detailed descriptions which have been published by Dr. A. Brammall and others on the heavy mineral assemblages of the major granite-masses of Devon and Cornwall. Although it has been found possible to distinguish to a fair extent between the detrius from the various granites, the danger of confusing detrital material from Cornish granites with that from Dartmoor in the sediments of the South of England is largely obviated by the fact that detritus from the Cornish granites does not appear to have gone east of Dart-

moor to any very appreciable extent, and that there are comparatively few post-Carboniferous sedimentary strata west of Dartmoor.

For the sake of brevity, no reference is made in the paper to those horizons in which Dartmoor detritus was not found.

The minor intrusions above the granite were being rapidly eroded in Permo-Triassic times, but there is no evidence of the actual granite being exposed at that period. The minerals of the pneumatolytic and contact-zones of the minor intrusions consanguineous with the granite were distributed in large quantity east and north-east of the Dartmoor area, but no evidence of them was found in the Slapton outlier.

No proof has been obtained of direct derivation of detritus from the Dartmoor ranite in the Jurassic rocks.

The earliest evidence of the exposure of the granite is in late Wealden times. Aptian yields mostly negative evidence. Throughout Upper Cretaceous times—particularly during the Selbornian epoch—the Dartmoor Granite contributed enormous quantities of detritus to the sediments of Southern England, reaching as far afield as Kent and Oxfordshire, and perhaps farther.

The Thanet Sand is barren, and the Reading Beds yield but very scanty evidence. The London Clay appears to be barren, except in West Dorset. Dartmoor detritus is present again in large quantities in the Bagshot Beds of Devon and Dorset, but east of the New Forest the evidence of it is obscured by increasing quantities of material from Armorica. The higher Eocene strata have yielded negative evidence.

The Oligocene of the Isle of Wight also yielded negative evidence.

The Aquitanian deposits of the Bovey and Petrockstow basins are, as already shown by Prof. P. G. H. Boswell, mainly derived from the Dartmoor Granite.

The Cornish Pliocene was largely derived from the Cornish granites. The St. Keverne outlier is mainly derived from the Falmouth and Bodmin masses, and yields no evidence of Dartmoor detritus.

A number of new occurrences of dumortierite are recorded in the paper.

SOCIETY OF PUBLIC ANALYSTS.

Papers read on April 8, at the Chemical Society's Rooms :—

Furfural and Diastase in Heated Honey. By L. H. Lampitt, D.Sc., F.I.C., E. B. Hughes, M.Sc., F.I.C., and H. S. Rooke, M.Sc., A.I.C.

Modifications of Fiehe's test and the aniline acetate test for furfural have been devised, which give strong reactions with honey containing 5 per cent. of added invert sugar. If honey gives pronounced reactions with both of these tests it is probably adulterated, unless there is evidence that it has been strongly heated. Such honey has usually been found to be caramelised and unfit for use. Honey heated for 24 hours at 60° C. usually gives negative results in the furfural tests, both immediately and after storage for several months.

There is definite evidence that honey contains two diastatic enzymes, for it reacts with starch, yielding both dextrins and reducing sugars. If honey is heated above 85° C., its diastatic activity is very rapidly destroyed.

Further Notes on Methods of Sewage and Water Analysis; Anti-Oxidation and Stabilisation of Pollution. By J. W. Haigh Johnson, M.Sc., F.I.C.

Comparative results on river waters have shown that the Graph Standard method is much to be preferred to the Royal Commission's test, owing to its superior technique and adaptability. The results given by the latter method are usually only half those given by the former.

The main types of biological oxidation curves are recognisable for polluted liquids : (1) *Unstable type*, characterised by very rapid, fairly uniform absorption of not more than 5 days' duration followed by: (2) *Semi-stable type*, having greatly diminished but very uniform oxidation rate, of indefinite duration, until : (3) *Nitrification* supervenes.

Type 1 indicates gross unstable pollution; type 2 indicates semi-stable pollution, and may show affinities with either 1 or 3. Correlation of biological and chemical absorption results shows that, in spite of apparent agreement, biological absorption produces an irregular effect on the chemical requirements. From one-third to two-thrids of the chemically determined organic matter is recovered from sewage during purification without any appreciable absorption of oxygen. The effect of oxygen on sewage pollution is apparently to oxidise unstable substances to the usual end-products, whilst the semi-stable substances are stabilised and precipitated as a relatively non-oxygen absorbing mud of ever-increasing stability.

Potassium Cyanate as a Reagent for the Detection of Cobalt. By B. J. F. Dorrington, B.Sc., A.I.C., and A. M. Ward, B.Sc., Ph.D., A.I.C.

Potassium cyanate reacts with cobalt to form a blue complex. The test, which is most sensitive when the reagent is used in alcoholic solution, is capable of detecting cobalt in a one-hundredth molar solution of cobalt nitrate. In the presence of nickel the test is applied to an ammoniacal solution of the mixed sulphides, and in the presence ol iron the precipitate formed with the reagent is allowed to settle overnight, and the test applied to the filtrate. Copper should be removed before testing for cobalt.

NOTICES OF BOOKS.

The Biochemistry of the Amino Acids. By H. H. MITCHELL (Professor of Animal Nutrition, College of Agriculture, University of Illinois), and T. S. HAMILTON (Associate in Animal Nutrition at the above University). Price $9.50.

This is one of the very useful of the American Chemical Society Monograph series, is uniform in get up and style, with its predecessors, and like them, published by the Chemical Catalog Company, Inc., 419, Fourth Avenue, at 29th Street, New York, U.S.A. The author's point out that the field of Animal Biochemistry, and of Nutritional Physiology, has in the last two decades or so been experiencing a rapid expansion. This is true of all countries, but probably more so in the United States and some of the newer countries than in the older countries, some of which owe their financial existence to agriculture and the various domestic animals which live on the land. The monograph extends to 620 pages, included under ten chapters, *viz.* (1) The Physical and Chemical Properties of the Amino Acids; (2) The Determination of the Amino Acids in Proteins; (3) The Determination of the Individual Amino Acids; (4) The Liberation of the Amino Acids in the Intestinal Tract; (5 & 6) General Amino Acid Metabolism; (7) Special Phases of Amino Acid Metabolism; (8) The Specific Dynamic Effect of Amino Acids; (9) The Endogenous Catabolism; (10) The Nutritive Values of Proteins and the Protein Values of Foods in Nutrition. There is an exhaustive Index extending to over 80 pages, so that any particular fact can be readily consulted.

A Pocket Book for Chemists. By THOMAS BAYLEY, Assoc.R.C.Sc.I. Edited by ROBERT ENSOLL. Ninth Edition. F'cap 8vo. Pp. 476. Price 8s. 6d. net. (Postage 4d.) London: Messrs. Spon, Ltd., 57, Haymarket.

Handy in size, neatly got up and handsomely bound, this book will be found useful by all persons interested in chemistry and kindred sciences. The contents of the 476 pages are sufficiently varied to interest any reader, while the range of matters dealt with and the well-arranged index renders the store of knowledge contained in the book readily accessible to the reader.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Monday, April 22, at 8 p.m.—(Cantor Lecture.) Sir E. Denison Ross, C.I.E., Ph.D., Director, School of Oriental Studies: "Nomadic Movements in Asia." (Lecture II.)

Wednesday, April 24, at 8 p.m.—(Ordinary Meeting.) H. L. Fletcher, of the British Broadcasting Corporation: "The Educational Value of Broadcasting."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

9,745.—Boot's Pure Drug Co., Ltd.—Production of monohydric phenols. March 26.

9,824.—Fletcher, W. B., and Imperial Chemical Industries, Ltd.—Production of hydrogen cyanide. March 27.

9,559.—I. G. Farbeninudstrie Akt.-Ges. —Working up salt mixtures. March 25.

9,561.—I. G. Farbenindustrie Akt.Ges. Manufacture of blue vat dyestuffs. March 25.

9,562.—I. G. Farbenindustrie Akt.-Ges. Manufacture of vat dyestuffs. March 25.

Specifications Published.

308,187.—Lehmann, M.—Filter material for hot or acid or alkaline gases and liquids.

308,468.—Smith, H. G., Bridger, C. J., and Imperial Chemical Industries, Ltd. —Production of ethyl alcohol.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

305,645.—Granulating sodium sulphide, etc.—Kali-Chemie Akt.-Ges., 10, Reichstagsufer, Berlin.

In the production from sodium sulphide and similar chemical substances of bodies of pre-determined shape and size by allowing individual drops of the molten substance to fall on to surfaces maintained below the melting point of the substance, as described in the parent Specification, the surfaces are preliminarily treated with highly viscous substances, for instance with highly viscous oils or fats, to prevent spreading of the drops. A sufficiently thin film may be obtained by application at high temperatures or by application in solution followed by volatilisation of the solvent. Cylinder oil or high pressure compressor oils for instance, may be applied in solution in benzene.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

VECTOIDS.

499,256.—Chemical substances used in manufactures, photography, or philosophical research and anti-corrosives. — Vectoids, Ltd., 42, Ranelagh Road, Pimlico, London, S.W.1. April 3.

NATUREME.

499,905.—Chemical substances prepared for use in medicine and pharmacy.—Frank Christopher Edmunds, 104, Drews Lane, Ward End, Birmingham. April 3.

CHEMALTOL.

500,446.—Chemical substances prepared for use in medicine and pharmacy.—Cuxson, Gerrard & Co., Ltd., 26, Fountain Lane, Oldbury, Worcestershire. April 3.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices: Merton House, Salisbury Square,
London, E.C.4.

THE CHEMICAL NEWS
and Journal of Industrial Science.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices: Merton House, Salisbury Sq., London, E.C.4.

Anti-Acid Specialities!

"CONTRACITE" Compressed Cubes.

"KAUTSHIT" Cloth

A Perfect Resistant for acids.

Sole Makers: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3602.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:

Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Physical Constants 257
By F. H. Loring.
Physico-Chemical Studies on Bioluminescence 258
By S. Kanda.
Some Aspects of the Manufacture of Starch and Glucose 260
By J. A. McLachlan, M.Sc.
Oxygen-Compound Formation with Acetaldehyde at Low Temperature 264
By D. LeB. Cooper, M.Sc.
General Notes:—
History of Fast Dyes and Dyeing ... 264
Britain's £80,000,000 Smoke Bill ... 267
New Cement Development 268
Important British Power Station Using Pulverised Fuel 268
Nine Millions Gallons a Year Supply of Petrol Available 269
Catalogue of Plans of Abandoned Mines 269
Proceedings & Notices of Societies:—
Geological Society of London 270
Institution of Civil Engineers 270
Forthcoming Events 271
New Patents 272
New Trade Marks 272

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

PHYSICAL CONSTANTS.

(*Concluded from page 248.*)

If it is desired to ascertain what the value of e is to give π accurately according to the equation on page 229, this is easily done by first computing the value approximately by accurate calculation when using certain values, particularly 4.776, then solving from the ratios

π computed : πtrue $= 4.776^2 : x$,

$\sqrt{x}$ being the value that gives true π which in this case is 4.77608 for 7 places of decimals of π, when using the values for the constants c and h under Flamm's equation according to my equations for them.

e has been evaluated from the well-known equation

$$e = 107.880 \times c / 10NE,$$

when 107.880 is the atomic weight of silver on the O = 16 basis, c the velocity of light as given earlier in this survey, N Avogadro's number, and E the electrochemical equivalent of silver. A difficulty arises in this case, for N is not accurately known, and moreover the question arises as to the mass function of the free electrons in the electrolyte as silver is in an ionic state when being carried through the solution. Are the electrons involved to be subtracted in one case and added in another? In this Journal (Jan. 11, 1929, vol. 138, p. 18) I attempted to evaluate N which came out at 6.0616×10^{23}.* The electrochemical equivalent of silver is $107.880/F$ (for F see first part of this article, p. 228) which is generally taken as 0.001118. Using these values gives a low one for e, *viz.*: $4.7724a$, a being the 10^{-10} multiplier.

On the other hand e/m can be evaluated from the equation—

$$(e/m) \times 10 = (m_H/m)(F/m_H),$$

when m_H is the mass of the hydrogen atom without its electron, and F the Faraday constant, m being the mass of the electron. These masses can be taken on the O = 16 basis in the right-hand side of the equation. In this case m is not known with sufficient accuracy to be of more than approximate

* A note of caution is necessary here. A cabalistic type of equation might be found to give what appears to be the correct answer. This might arise from the true value not being as expected, so that the agreement is a pure chance coincidence. If the 'true value' was really the true value, then there would be some reason for supposing the equation to be a true one, though perhaps not understood in a functional sense.

service, as the noughts do not count for accuracy (in the sense here intended) when *before* the significant figures. The usual value for m is 0.00054... on the O = 16 basis, but the figures beyond the 4 make considerable difference in the result. In this Journal (March 16, 1928, vol 136, p. 161) I took as a very close working value

$0.000\dot{5}\dot{4}62$, H at 1.00778 (Aston's precision mass value, O = 16) and 96470 for the Faraday constant as used by Houston (*loc. cit.*) in his calculations, and obtained the value for $e/m = 1.7660 \times 10^7$ E.M.U. Using the value of F given by Birge (see p. 228) gives the value for e/m as 1.766348×10^7.

Values derived from spectroscopic methods may involve π different from the standard value as I have already indicated. The reason for this suggestion is apparent if the sub-atomic conditions involve distortions in the geometric scheme of affairs.

In using the various constants, there are tacit assumptions involved and when practically absolute all-round agreements are to be obtained correcting factors may be necessary.

Physicists hold various opinions in these matters and while the constants here discussed are in general agreement and which nobody can doubt, when it comes to *precision values* there will be much diversity of opinion, which can only be settled by more refined experiment. It is certainly remarkable how exact some of the values have been measured, particularly the new velocity of light by Michelson.

It is apparent, assuming the constants e, h, c and R_∞ as accurately adjusted, that such values as F, N, m, and the *atomic weight of silver* can be determined therefrom if no correcting factors are involved—see above. Ag is fairly accurately known the decimal error being ± 0.001.

In using the word *important* on page 248, it should be noted that this is relative as all things are really important.

When trying to ' agree ' figures it is often desirable to work out the calculation to many decimal places for comparative purposes, and it saves the reader the trouble of making long calculations if he should wish to try out combinations of values, but such values are quite hypothetical from the point of view of extreme accuracy.

On page 242 insert equals sign between the c and $2\pi^2$ in the equation. Also change the c^2 to read e^2—12th line down, 1st column on page 248.

F .H. L.

PHYSICO-CHEMICAL STUDIES ON BIOLUMINESCENCE. — VII. THE SOLUBILITY OF CYPRIDINA LUCIFERIN IN ORGANIC SOLVENTS.

By SAKYO KANDA.

(*Scientific Paper of the Institute of Physical and Chemical Research, Japan.*)

(*Concluded from page 248.*)

ISOLATION WITH BENZENE.

So far the facts are not quite new. The residue prepared with ethyl alcohol was added to about 500 c.c. of absolute benzene. It likewise gave a bulky precipitate. The precipitate was filtered off and thoroughly washed with pure benzene. It dissolved incompletely in water. The solution still gave Millon and ninhydrin reactions which pointed to the presence of some protein material. It contained, however, no trace f luciferin because it produced no light with Cypridina luciferase.

On the other hand, the supernatant fluid was filtered off twice with a heavy filter paper and the filtrate was perfectly clear. This clear filtrate showed no colloidal particles under the ultramicroscope. The evidence indicated that there was no possibility of sol formation in the benzene extract. But the filtrate contained a very large amount of the luciferin, if not all of it, as a few drops of it produced a beautiful light at the boundary if the aqueous soluton of luciferase was added in excess. The fact that Cypridina luciferin becomes soluble in benzene should be particularly emphasised here.

The filtrate was readily evaporated down to about 30 c.c. of syrup in the same way as in the case of the methanol solution. The residue was poured into a 500 c.c. beaker and was again evaporated to dryness on the water bath. The residue was dried in the desiccator over $CaCl_2$ in vacuo and was kept wthout complete disappearance of light producing power for over one month. There was a gradual diminution, to a final disappearance, of this power.

The dried residue completely dissolves in absolute methanol as might be expected and the solution examined under the ultramicroscope shows no colloidal particles at all. If the solution is diluted with water, numerous small colloidal particles are formed. Nevertheless it produces a brilliant light if mixed with luciferase. That the aqueous solution of the residue gives no Millon and ninhydrin reactions any longer and that a protein or protein derivatives and the colloidal particles, present all together in the methanol extract of the fat-

free body parts of Cypridinas as well as in the ethyl alcohol solution of the methanol extract, are not different entities but identical, will be proved by these facts. The reason is simple as the colloidal particles disappear in the methanol solution of the residue prepared with benzene at the same time when a protein or protein derivatives which give Millon and ninhydrin reactions also disappear in the same solution.

Furthermore, it will be likewise proved that the luciferin of Cypridina is not a "natural" protein, if it is one at all as some believe it to be, because no protein which is soluble in pure benzene is found in nature as yet whereas the luciferin is perfectly soluble in benzene.

DISCUSSION.

The fact that Cypridina luciferin, which is formally insoluble in benzene, chloroform, ether, etc., becomes perfectly soluble in any of the solvents after its isolation with methanol and ethyl alcohol is evidently clear. The question then arises how the soluble character of luciferin changes after it is treated with alcohols. There is not at present any way of deciding this question but some explanation may be given in a tentative way.

As the evidence points to the presence of a protein or protein derivatives given in alcohol solutions, the protein material seems to be associated with Cypridina luciferin in o way which is not at present known. Possibly in the body of the animal, though dried, their association may be more rigid than in the alcohol solutions. Unless any of the solvents, therefore, can dissolve the protein material, it can not extract luciferin in consequence. As no protein is soluble in benzene, chloroform, ether, ets., none of the solvents can extract luciferin when it exists together with its associate or associates, that is, a protein or protein derivatives, in the fat-free body parts of the animals which are prepared in the course of 153 days, even though it be soluble in any of them as its natural character if it be alone. On the other hand, some alcohols, methanol in particular, can dissolve a certain protein or protein derivatives and also extract luciferin together with some protein material. In the alcohol solutions the association tie of luciferin with the protein material may be made loose, as ethyl alcohol separates luciferin from the protein material to a certain extent, as is already shown. If the association tie is once loosened up, the separation of luciferin from its associate or associates seems to become quite easy. The luciferin thus becomes soluble in benzene, chloroform, ether, etc., after its isolation wth alcohols. Whatever the explanation may be, this much is true, that Cypridina luciferin is perfectly soluble in benzene, chloroform, ether, etc.

In a strict sense, however, this is not a change in the soluble character of luciferin itself at all. In reality it is a change in the surroundings of luciferin. In short Cypridina luciferin should be a chemical substance which is perfectly soluble in alcohols, benzene, chloroform, etc. In other words, the luciferin and the protein material are entirely different substances although Cypridina luciferin is always extracted together with a protein or protein derivatives if alcohols are used.

Harvey believes Cypridina luciferin to be "a new natural proteose" or peptone, whereas Dubois believes Pholas luciferin to be a natural albumin. Harvey has prepared Cypridina luciferin with hot water. His preparation of luciferin is no doubt much contaminated with a protein or protein derivatives, which have certainly confused his experimental results. If it is simply judged, however, from the solubility relations of Cypridina luciferin, there is no evidence which indicates that luciferin is of a protein nature. But it is quite the contrary, as no protein which is soluble in benzene, chloroform, ether, etc., is found in nature as yet, although there is not at present a direct evidence which proves that luciferin is not a protein. The question whether Cypridina luciferin is a protein or not will be decided by further experiments which are now in progress.

SUMMARY.

1. The solubility of Cypridina luciferin in petroleum ether, ether and benzene is not detected in any way during 153 days, while the fat or fats of the body parts of the dried animals are being extracted with the solvents.

2. The luciferin of the fat-free body parts of the animals is isolated together with a protein or protein derivatives with methanol and ethyl alcohol.

3. Both the alcohol solutions of luciferin show colloidal particles under the ultramicroscope.

4. After the filtrate of the ethyl alcohol solution of luciferin, after its isolation with methanol, is evaporated down to a syrup, the lucferin becomes soluble in benzene, chloroform, ether, etc.

5. The benzene solution of luciferin is not colloidal and gives no protein colour reactions.

6. The protein material seems to be

associated with luciferin in some way in the body of the animal as well as in alcohol solutions.

7. The luciferin and the protein material in the alcohol solutions are not identical substances but entirely different ones.

SOME ASPECTS OF THE MANUFACTURE OF STARCH AND GLUCOSE.

By J. A. McLachlan, M.Sc.

(Abstracted from the *Journal of the South African Chemical Institute.*)

The object of the present paper is not to describe the methods of starch and glucose manufacture from maize in detail, but to discuss some few problems which arise in the manufacture of these products; the problems selected are those which are chemical in nature and thus amenable to the application of chemical principles.

In so far as starch manufacture is concerned, the scope for the application of chemical principles is more limited than is the case in glucose manufacture; for the former is fundamentally a process of mechanical separation, while the latter involves chemical changes throughout.

Starch Manufacture.

Brief reference may be made to the utilisation of dilute solutions of sulphur dioxide in water (0.11 per cent. SO_2) for soaking the maize in order to soften it for the subsequent grinding operations, to prevent germination of the endosperm, and to the use of more dilute solutions (0.04 per cent. SO_2) during the course of manufacture to prevent mould growth and fermentation of the starch during the lengthy washing operations.

The ultimate object of starch manufacture is the preparation of a starch with the smallest amount of impurities. Using maize as raw material, the manufacture involves the complete separation of five components from each other, *viz.*, the husk or outer covering, the mineral salts, the germ or oilbearing endosperm, the gluten or nitrogenous portion, and the starch. The satisfactory separation of the two latter presents the most difficult problem in manufacture, for the remaining separations can be completed mechanically. The husk separates readily from adhering starch and gluten on fine grinding and screening, the mineral salts are largely leached out during the steeping process, while the germ separates cleanly by virtue of its oil content and lower specific gravity. The starch and gluten, however, are very intimately associated, and are not completely separated even by chemical treatment of the gluten.

Most of the uses to which starch is applied demand the presence of only minimal amounts of this substance. In laundry work, high gluten percentages are responsible for fabrics adhering to the hot iron and to discoloured fabrics. In confectionery work, "sloppy" moulds result which do not separate clearly from the sweet, and the drying efficiency of the moulding starch is greatly reduced. For household cooking a starch with high protein content may be responsible for discoloured and bitter tasting blancmanges, etc. For glucose manufacture a starch with a minimum amount of protein is a *sine qua non*. The gluten and starch are separated on long, very slightly inclined tables, where the higher specific gravity of the latter causes it to settle out rapidly from a suspension of the mixture, while the lighter, more flocculent gluten, flows away. Starch recovered in this way contains from 0.07 to 0.35 per cent. of protein. Starch containing more than 0.5 per cent. protein may be regarded as only second quality, and is not suitable for manufacture into cornflours, household "crystal" starch, nor glucose. Apart from these disadvantages, a high protein starch leads to many difficulties from mould growth, in the subsequent manufacture.

In the manufacture of crystal starch, starch taken from the tables is washed with SO_2 water in wooden tanks and allowed to settle. After being mixed to a heavy suspension, it is run into drip boxes, where the water filters away and leaves a loaf of starch about $6' \times 9'' \times 9''$.

The loaves are cut into cubes and placed on trucks which are run into drying kilns fed by a blast of hot air. A twelve hours drying produces a crust about $\frac{3}{8}''$ deep, which contains a high percentage of the impurities present in the original block. The impure crust is cut away and the clean cube wrapped in heavy brown paper, and placed on racks on trucks. The cube is then subjected to a very gradual drying process over a period of 14 days.

Reference was made earlier, to the importance of a low protein content in the starch. It is at this drying stage of the process that the importance of this factor is most fully realised. In the first place, starches of higher protein content than 0.5 per cent. do not develop the clean shrinkage fractures which divide the block into the familiar columns or "crystals." The crystals resulting are irregular in size and

shape, while the centre of the block may be often one large lump. Such a product is quite unsaleable. In addition, the starch will possess a dirty grey colour. Similar troubles may develop in starch of low protein content, if drying conditions in the kilns are not correctly controlled, but in high protein starches, no method of control will produce a good crystal. The most important trouble resulting from high protein starches is, however, the growth of moulds. Many factors have been investigated in this connection, but from the work carried out it is concluded that the rate of drying and the protein content form two limiting factors. It will be readily appreciated that the conditions obtaining in the interior of a wrapped block of starch are peculiarly liable to foster bacterial and mould growth, *i.e.*, the block is situated in a dark, warm and humid atmosphere, and a very rich medium is present as food supply. Provided, however, that desiccation of the block is regular and progressive, the mould spores do not find favourable conditions for development, for by the time germination has taken place, the block has dried out to such an extent that growth is inhibited. On the other hand, if after, say, one day's slow drying at about 85° F., the temperature is allowed to fall there is a tendency for moisture to be redeposited on the outside of the block and the germinating spores are not subjected to any inhibiting conditions. Air borne spores of various moulds and bacteria are bound to be present in all the starch but in a low protein starch the tendency to mould growth under uncontrolled kiln conditions is much less serious than in starches of high protein content, where a richer nutrient medium is available.

GLUCOSE MANUFACTURE.

For many years in the early history of glucose manufacture the industry was run on purely rule-of-thumb lines and progress was correspondingly slow. The rapid rise of the industry in America and the increasing scale of operations there, rendered the application of scientific control imperative. Advances followed rapidly, the force of competition forcing the older industry in Europe, and particularly in Germany (the home of the industry) to improve its methods along scientific lines.

In the manufacture of glucose from starch, the quality of the raw material is of primary importance, and effort is still concentrated on completely refining the starch before it is converted. As starch is a free-filtering, rapidly-settling substance, it is better adapted to purifying operations than is glucose, so that the nature of the treatment to remove any substance from starch is less expensive than the treatment of glucose juice to remove the same substance. The consumption of industrial starches in this country is relatively very low compared with that of household starches, which are of a much higher quality. In the ordinary course of manufacture, about one third of the total starch recovered is recovered as first grade starch suitable for household products. The remaining two thirds, of inferior quality, is not consumed as in other countries by gum-makers, laundries, textile works, confectioners, etc. Starch of first quality is essential for the manufacture of the best grades of glucose, but until the consumption of second quality increases, the amount of first quality cannot be raised to meet the demands of both household starch and glucose.

The essential difference between the two grades lies in the protein content, which averages about 0.4 per cent. in the first and 0.7 per cent. in the second grade. The content of oil, fibre, and mineral matter is also higher in the second grade.

In converting starch to glucose, the former is boiled to a limpid paste in large, closed, copper vessels, heated by steam. At Germiston a departure from universal practice is made, by carrying out the boiling with closed, instead of open, steam coils, and maintaining vigorous agitation by compressed air. This gives rise to many difficulties not experienced with open or direct steam, and considerable work was necessary before the correct conditions for satisfactory operation were evolved. It is imperative that a uniform, completely gelatinised paste shall result from the boiling, but extreme caution in the rate of starch addition is necessary to secure this; one of the greatest difficulties is to avoid too rapid addition of the starch, when the formation of large lumps of partially gelatinised starch results. These lumps do not disintegrate on boiling, but adhere to the steam coils, and form a most effective insulation.

The conversion is carried out in the presence of approximately 0.05 N HCl under a pressure of 3 atmospheres, the degree of conversion being followed by the iodine reaction. The quality and properties of the finished glucose depends to a very large extent on the degree of conversion, *i.e.*, on the extent of the transformation of the starch present to dextrose. For confectioners products, the conversion is carried to a point

where a sample produces no change of colour with iodine, the finished product then contains about 37 per cent. dextrin, 43 per cent. combined dextrose and maltose and about 20 per cent. water.

A serious problem arises at this stage in the solution of copper from the converter. Although copper is generally considered insoluble in any but strong HCl, solution is sufficient to demand attention in a foodstuff. The number of methods by which copper may be removed from solution must naturally be very limited, but it is fortunate that copper is precipitated as an insoluble carbonate by solutions of the alkali carbonates. After being discharged from the converter, as a thin sugary liquid, the juice is neutralised by sodium carbonate. This operation of neutralisation is a most interesting one from several aspects and is closely concerned with the elimination of copper from the juice.

In addition to neutralising the free acid present and coagulating the colloids, the carbonate precipitates copper salts as carbonates. This question has been very thoroughly investigated by us, and some rather interesting facts have come to light. We find that although copper is quantitatively precipitated from its salts by sodium carbonate, such is never the case when glucose juices are present. Thus no copper is detected in the filtrate from the precipitation of copper chloride by sodium carbonate, when the filtrate has an approximately pH value of 5.1, but as soon as glucose juice is added copper is present in the filtrate, even when carbonate is added to a lower value than pH 5.1.

There is a short range of acidity within which precipitation of copper is maximal. We define this condition as such that 10 c.c. of the juice neutralises 0.4 to 0.6 c.c. N/10 NaOH to phenophthalein, and a pH of 5.0 to 5.1. The copper remaining in the juice represents about 12 parts per million of finished product, which is considered safe. The filtration of this neutralised juice presents a most difficult problem, and glucose juices in general are regarded as among the most difficult substances which a manufacturer has to handle. Much effort has therefore been devoted to the investigation of conditions of coagulation making for easiest filtration. Among many factors influencing the ease of filtration, the degree of conversion, the rapidity of conversion, the protein content, and the point to which neutralisation is carried, are the most significant. It is surprising that the question should be so involved, when one considers that the total weight of impurities is of the order of 90 lb. on a weight of juice of 10,000 lb. = 0.9 per cent. Glucose filtration is an expensive operation since it involves heavy capital outlay on presses (approx. 0.5 sq. ft. per gallon is required), heavy labour charges in cleaning after each cycle (1½ hours) and heavy maintenance of filter cloths on account of frequent washings.

Sulphur dioxide as such, or in one or other of its many forms as sulphites, is invariably used in glucose manufacture, and its use raises some interesting points. A satisfactory confectioners' glucose cannot be made without the use of sulphite, but it can only be added to the juice under limited conditions. The SO_2 is necessary not only to produce a bleaching in the juice of coloured organic and inorganic compounds (such as iron salts) but exercises its chief function during the confectioners' boiling, when it counteracts the darkening resulting from the direct heat of a fire and produces a confection of more delicate tint than would otherwise be obtained.

It was explained that neutralisation by Na_2CO_3 was carried to a point such that 10 c.c. of the juice neutralised 0.4 to 0.6 c.c. N/10 NaOH to phenolpthalein, or approximately 0.01 per cent. of HCl. Such a juice is acid (pH 5.1) but the free mineral acidity is not so high as is represented by the titratable acidity. Since sodium sulphite (the salt most generally used) is strongly basic in solution the addition of even small amounts would leave the juice alkaline, and as is well known an alkaline glucose is very sensitive to heat, while the chief property of confectioners' glucose is that it is less sensitive to heat than are other sugars. It is necessary to add about 800 mgms. SO_2 per litre, and the juice requires a final acidity such that 10 c.c. = 1.0 c.c. N/10 NaOH or abont 0.03 per cent. HCe. This addition of sulphite does not affect the titratable acidity very appreciably, but the pH value may be lowered to about 4.3 to 4.5. In order to introduce sulphite, therefore, an addition of acid becomes necessary, which is advantageous to a slight extent in increasing the activity of the char, before it is neutralised by the sulphite. An alternative method which is applicable under certain conditions is to leave the juice with a titratable acidity sueh that 10 c.c. = 1.2 c.c. N/10 NaOH. Under such conditions no further addition of acid is necessary before adding sulphite. The quantity of sulphite mentioned above

leaves the finished product with about 480 mgms. free SO_2 per litre.

CLOTHING OF GLUCOSE AND COOLING.

Confectioners' syrup is evaporated to a gravity of 42 to 44° Bé (S.G. 1.42 to 1.44). At Germiston the evaporation is carried out in a Kestner evaporator, which is able to operate at a higher juice temperature than the vacuum pans generally employed. This final evaporation is carried out at 80° C. in order to make the syrup workable, while the evaporation in vacuum pans is completed at a temperature as low as possible, generally at about 48° C.

In order to preserve the clarity, flavour and water-white appearance of the syrup an elaborate cooling of the product is necessary before it is delivered into the containers. Unfortunately cool confectioners' glucose is practically a solid product, and the trade tradition is that it should be packed in barrels which are filled only through a 2″ bung. It cannot be run into barrels hot, for being very viscous and a bad conductor of heat, cooling is very slow in a wooden container, with the result that the syrup " stews on itself," so to speak, for about a week. A yellow tint and generally a slight bitterness develop as a result.

It is a difficult product to cool because immediately the hot mobile syrup comes into contact with a cold surface it becomes very viscous and adheres to the surface, preventing the cooling of succeeding amounts. An exceptionally large cooling installation becomes necessary for a relatively small amount of product. The cooler generally takes the form of a sharply inclined water jacketed cascade, although a rotating drum cooler is indicated by the nature of the product.

ANALYTICAL CONTROL.

The quality of raw material is of first importance in glucose manufacture and as protein is such an important factor, this is the only component which is estimated regularly. Periodical complete analysis for fibre, ash, and fat are required, when the protein determination indicates any irregularity. The density of the starch milk also requires careful estimation in order that yields may be arrived at.

Neutralisation is controlled at the tankside by simple titration to caustic soda and phenolphthalein. This is easily taught to operatives, although the control of the operation by pH colorimetric methods would be an advantage. Unfortunately the pH of the juice changes very little during neutralisation, so far as can be judged from a small amount of preliminary work.

The decolorisation process demands control at the tankside also, but the condition of the juice varies so much at this stage that it is hardly a control which can be left in the hands of operatives.

The finished product is examined for acidity, reducing sugars, dextrin and occasionally for protein, fat and ash.

The acidity, reducing sugars, dextrin and occasionally for protein, fat and ash.

The acidity figure is determined by titration to caustic soda and phenol phthalein and is useful in conjunction with the pH value in assessing the inverting power of the glucose. Ash is only of importance when mineral contamination is suspected. The percentage of this constituent varies considerably from about 0.3 to 1.0 per cent., but is so erratic that no deductions as to the quality of the syrup can be made.

Reducing sugars and dextrin determinations are most essential, for upon the relative proportions of these two components, the chief properties of the syrup depend, *viz.*, its resistance to heat, and its non-crystallising power.

Glucose syrups are used in sweets for a large number of reasons. Some of its properties may be obtained from substitutes, but for two of them there is no satisfactory substitute. It darkens less on heating than does sucrose and it makes a non-crystallising, smoother, firmer and non-deliquescent sweet. Both these properties depend almost entirely on its dextrin content, which should be approximately 37 per cent. in a good confectioners' glucose. The total reducing sugars average 40 to 45 per cent., but considerable variation occurs in the maltose-dextrose ratio. In general about 12½ per cent. of the reducing sugars are present as maltose. The relative proportions of these components is determined in the converter operation, but on account of the complex nature of the reaction, with its many varying factors, and of the fact that no other method of control than the reaction to iodine is sufficiently rapid for works control, variations of about 5 per cent. in the individual components are quite common. A certain amount of such variation may be removed by mixing different conversions.

Reducing sugars and dextrose are determined by a combination of optical and copper reduction methods, which are very elaborate and unsatisfactory from the point

of view of works control. It is still more or less an open question whether the figures obtained for maltose, in particular, are very reliable.

OXYGEN-COMPOUND FORMATION WITH ACETALDEHYDE AT LOW TEMPERATURE.

By D. LeB. Cooper, M.Sc.
Chemistry Department, Dalhousie University, Halifax, N.S.

(Before the Nova Scotian Institute of Science.)

Some evidence of the formation of a peroxide during the oxidation of acetaldehyde at low temperatures has been brought to my attention. The following experiment was designed with the object of gaining some information about the supposed reaction.

A small amount of acetaldehyde, together with finely powdered manganese acetate, was placed in the ordinary form of a bubbling tube which was kept immersed in a carbon dioxide-ether bath. Oxygen was circulated through this mixture by means of a Maass circulating pump. The oxygen was stored in a graduated cylinder, and admitted to the apparatus through a side arm on the bubbling tube, after having passed over phosphorus pentoxide, a tube of which was placed in series between the reservoir and the tube. During the circulation the storage system could be shut off by means of a series of stop cocks. An attempt was made to admit the oxygen directly into the pump, but this proved unsatisfactory owing to trappage of oxygen in the valve. Circulation with the tube empty and the apparatus arranged in the second manner showed that there was no trappage of oxygen.

Following are two typical experiments with acetaldehyde and the catalyst in the tube :

Time	Absorption c.c.	Time	Absorption c.c.
3.30	0	9.45	0
3.40	12	1.00	10
4.30	19	5.30	19
5.00	25	9.15	21
6.00	22	11.25	21

After the absorption the solution was a dark pink colour.

An analysis of the material thus treated was made with sodium hydroxide (N-.187) with the following results.

1. A test of freshly prepared acetaldehyde showed no trace of acid.

2. A run in which the following absorption occurred.

Time	Absorption c.c.
10.30	0
12.30	7

gave the following results when titrated for acetic acid.

Calculated amount of HAc from titration (.0043 and .0044) mean .004 gm. A calculation shows an absorption of 7 c.c. of oxygen is required for the formation of this amount of acetic acid from acetaldehyde.

In view of the fact that the absorbed oxygen reached a maximum in all runs that were allowed to continue for a period of over four hours, it is not improbable that this represents the solubility of oxygen in the acetaldehyde mixture, the oxidation power of the catalyst being absent at the low temperature of the experiment. On warming the solution it is possible that an immediate oxidation of acetaldehyde to acetic acid occurred, which would account for the value found above.

The pink colour of the solution may indicate the formation of some complex. If this be the case the formation must be very slow, and the product formed must rearrange to acetic acid on warming to room temperature.

The experiment indicates therefore, that no peroxide stable at room temperature is formed.

GENERAL NOTES.

HISTORY OF THE DEVELOPMENT OF FAST DYEING AND DYES.

By James Morton.

Paper read before the Royal Society of Arts, February 20.

(Continued from page 250.)

With these outside orders rushing in—we had one contract for 100 tons of colour—our Dye-making section was becoming a place of considerable activity, and it was at this time that we decided to detach it from our Textile business. It was then run under the name of "Solway Dyes Company," still owned and operated entirely by ourselves. I was averse then to inviting outside capital for a kind of business that had so many risks, and even now might only be temporary.

But, as you can realise, all that long research by chemists, and the erection of buildings and plant to cope with large production had made us dip fairly deeply into our coffers and we were only a comparatively small private concern. It was at this

time it occurred to me, why should we not try to interest some American makers in the results of our hard earned experience. The money would be very useful. Several firms over there had been making dyes, but none so far had attempted such a colour as Alizarine Sapphirole, and very little had been done on Vat dyes. These anthraquinone colours were bound to have a large demand in the American market, so we set out to interest some one in the making of them with a view to helping our finance in this obvious and natural way. It was still War-time, and negotiations were difficult, but during 1918 a plant was erected in America for the manufacture of a ton a week of our Solway Blue (Alizarine Sapphirole), from plans and processes prepared by us, and two of our chemists from little Carlisle went out to set that plant agoing in America. And it is working regularly till this day.

In the next year, 1919, I went to America with a view to further extending this idea, and it led to an arrangement between ourselves and a large Chemical Company in America that has been of extreme importance and mutual value. That arrangement has continued unbroken, and to-day they are supplying dyers and manufacturers of America with a large proportion of their very extensive requirements of Vat colours. There is a complete mutual interchange of information and experience. The advantages have been mutual and the association has been one of ever-increasing co-operation and cordiality.

But my visit to America at that time, which lasted some three months, had another result which turned out to be of far-reaching importance to our enterprise, and which I must relate as briefly as I can. By this time, the end of 1919, it was evident that our Dyes venture was to be no passing phase and we had already taken an important step towards its establishment on a permanent basis. This step I should like to record was taken shortly after, and as a direct result of a speech by the then President of the Board of Trade, Sir Albert Stanley as he then was, now Lord Ashfield. In this speech he had explained the Government policy, whereby there would be a certain regulation in the importation of dyestuffs for ten years after the War, and that certain Grants-in-aid would be given towards Research, and also towards construction of plant for colours not yet made in sufficient quantities in this country.

Up to this time all our Dyes activities had been operated in buildings adapted or erected within our textile area, and these were proving quite inadequate to cope with the demands now being made upon us. So we decided that the future developments should be on fresh fields—near the sea for effluent, and where we could have ample supply of suitable water and good transport facilities. Ultimately Grangemouth was chosen as fulfilling these conditions. There we got a site with an option on eighty acres and we then became Scottish Dyes Limited. At this juncture we indited the co-operation financially of only one outside party, a gentleman already interested in chemicals and thoroughly conversant with all the risks that might attach to a new Dye industry in this country. At a later stage a few of the larger Colour Users and suppliers of Chemicals also became financially interested in our undertaking.

The construction of this new place was going ahead while I was in America at the end of 1919 and beginning of 1920. We were laying the plans for the manufacture of Anthraquinone Dyestuffs on a big scale.

But one factor had often worried us, and now became more acute in view of these extensions, namely, the supply of anthracene, which was the basis of all our operations. This hydro-carbon forms a very small fraction of the coal tar, and very few distillers would trouble to extract it, with the result that any industry dependent on anthracene was at the mercy of a few people, and even in our short experience we had difficulties about supplies, while on several occasions we had to pay exorbitant prices. It was obvious that if another source could be found for our necessary raw material we should be on a much sounder footing for large operations.

It came to our knowledge at this time that a new process had recently been discovered in America for the production of Phthalic Anhydride from naphthlene by an air oxidation process. We had been aware that the production of anthraquinone from Phthalic Anhydride was an alternative source of supply for our starting material, but the cost of Phthalic Anhydride by any previous process had seemed to shut the door to this avenue. It struck us, however, that by this new air process the cost must be so low that it might bring the process within the field of possbility. So it was one of my other missions on this visit to America to investigate this process, and to see whether the conditions were such that it might solve for us this outstanding trouble of anthracene supply. For it was obvious

that if we could switch over from anthracene as our basic material to naphthalene we should be on absolutely safe ground, for not only is naththalene much lower in price, but the supply is practically unlimited, representing as it does a fraction in the coal tar some 15 to 20 times the volume of anthracene, and it is isolated by practically every tar distiller. It was worth any effort to enable us to realise a condition of this kind. But would it be possible for us to acquire the *process?*

I really must refrain from entering on the story of that deal in America for the British rights of this new process for the manufacture of phthalic anhydride. If I ever write a romance I think I shall call it by that sweet name. At any rate, suffice it to say that when I recrossed the Atlantic it was with this " ugly duckling " as part of my baggage. For when I presented it to our boys in the home yard and told them the cost, their congratulations, or their welcome, were, I am afraid, not too effusive!

But other things were happening in the dye trade just then that made the advent of expensive " ugly ducklings " not too propitious. I mentioned a short time ago that we had launched on our bigger scheme of dye-making on the basis of the Government promise to restrict the import of dyes for ten years. This declaration of prohibition was given under an Act of 1876, whereby the King had power to prohibit the importation of arms, ammunition, gunpowder, or any other goods, and the Government relied on the words " any other goods " to enable them to exclude chemicals and dyestuffs. In August, 1919, this was contested by a firm who wished to import certain chemicals, and the Court, by what was called the Sankey Judgment, held that the words " or any other goods " in that connection did not refer to chemicals or dyes, and that the Government had no power to prohibit the importation of these materials. As a result, there followed a full year in which users were free to import all the dyestuffs they wanted, and at the same time the Government saw fit to take as part of their reparation payments from Germany huge quantities of dyestuffs. So that during the year 1920 and into 1921 it is claimed that dyestuffs to the value of something like £7,000,000 were arranged for import to this country. At the same time the Indian market, which had formerly been considered a closed market to German dyes was made free to that country, with the result that large contracts which had been given to dye-makers in this country, ourselves included, were immediately repudiated. On the heels of this came what was known as the slump in trade, when demands for goods of all kinds seemed to stop in a single night. That combination of events made melancholy times indeed for the dye-makers here, who had erected or were just erecting plants to supply the total needs of the country and the Empire. It was a cold draught indeed, two years of a bitterer wind than one ever wants to know again.

But this hiatus, like adversity, was not without its uses. If our chemists were not needed for production they could research; they could improve and revise many existing processes, ond they could venture out on new fields. So in these two adverse years, though we drew in our horns in many ways, we did not dispense with the services of a single chemist. Indeed, it was a time of precious research, which bore much good fruit as you will see.

And, among other things, it gave time for our chemists to make better acquaintance with the ways of the little "ugly duckling" which I had thrown among them so unexpectedly. Like others, it had passed through a hazardous time enough. It seemed to contract certain foreign troubles as well as some home maladies, but at length it developed some quite unexpected feathers, and was soon to become the pet bird of the flock. For our chemists discovered that these beautiful long white crystals of phthalic anhydride were capable of flights they had never anticipated. We had certainly expected them to bring us anthraquinone from naphthalene that would make us at least independent of the more limited anthracene, and perhaps at a lower price. This was soon accomplished, but our chemists found that not only could they get an anthraquinone of the requisite purity much more easily, but that it offered a ready avenue to new and important derivatives of anthraquinone without the necessity of passing through the anthraquinone stage—the white wings of the phthalic made possible the flight free of that island altogether.

As you chemists may know, a simple transformation involving phthalic anhydride consists of the production of benzoyl-benzoic acid from it by condensation with benzene. Benzoyl-benzoic acid is simply anthraquinone with an extra molecule of water added to it, thereby leaving one of the links open between the two outside rings

of the molecule. When this ring is closed by extracting the water with an agent such as sulphuric acid, anthraquinone is formed. But in most of our operations for which anthraquinone is needed it is not necessary to isolate the anthraquinone, so that the benzoyl-benzoic acid acts as a raw material, and can be directly converted into any intermediate for which anthraquinone was formerly used. The application of this discovery by our chemists as a new use of phthalic anhydride is of far-reaching importance in the realm of Anthraquinone Dye-making, and is the subject of several Scottish Dyes patents. It now permeates into practically all branches of our many processes, and has enabled these anthraquinone derivatives to be made with a degree of purity and at a price that was unattainable from the old process from anthracene. Indeed it may be looked upon in the nature of a revolution in that section of dye-making.

One outstanding result of this process, and one that could never have been attained otherwise, is that it has enabled Scottish Dyes to make and put on the market a Vat Blue colouring matter, which it without question the fastest Blue on the market, and what is more, it is the fastest blue that has been made anywhere at any time, ancient or modern—a very big claim to make! It has only been on the market some three years, and it will give you some idea of its recognition by the users of dyes when I tell you that of this one blue we now make more tons a year than the total imports of all vat colours put together before the War. That I look upon as one of the greatest achievements of Dr. Thomas and his staff of Research Chemists, done largely during the slackness created by the "dump" and "slump" period—but, as I modestly remind them, something they could never have done but for the advent of my not too welcome "ugly duckling," the phthalic anhydride.

(To be continued.)

IMPORT TRADE OF NICARAGUA.

In the course of his Report on Economic conditions in the Republic of Nicaragua, Mr. H. S. London, British Chargé d'Affaires, mentions a number of lines to which United Kingdom exporters might turn their attention and discusses the prospects of British motor vehicles. Great Britain, by the way, ranks second only to the United States as an exporter to Nicaragua.

BRITISH TRADE WITH FRENCH MOROCCO.

Imports into the French Zone of Morocco from Great Britain showed some falling off in value for 1927 as compared with the previous year, but, writes Sir Andrew Ryan, K.B.E., C.M.G., British Consul-General at Rabat, when the 1928 figures are available it will probably be found that no further ground has been lost. With the exception of coal, Great Britain continues to hold a strong position in its most important staples.

BRITAIN'S £80,000,000 SMOKE BILL.

PROFESSOR WYNNE'S INDICTMENT OF RAW COAL BURNING.

"Many attempts have been made to estimate the cost through waste and damage of our present method of burning soft coal, but I doubt if this figure is capable of anything like exact computation," said Professor F. E. Wynne, Medical Officer of Health for Sheffield, in the course of a paper on "Smoke Abatement" to the Royal Sanitary Institute at Lancaster, on Saturday, March 23. "One quite conservative estimate of the annual loss to the nation of domestic fires alone is £80,000,000. I believe that the figure, if it could be ascertained, would be of this order."

A good deal, he said, had been done towards the reduction of domestic smoke by the increased use of gas and electricity, especially for cooking. Central heating for dwellings was not, in his opinion, a satisfactory scheme as, if not combined with open fires, it reduced ventilation. And it was certain that in his own climate the Briton would never be content without an open fire.

THE ONLY SOLUTION.

"I have long been convinced," he continued, "that the only real solution is to be found in the production of a smokeless fuel which can be sold at a price not greater than that of coal. Now, after years of failure, and the sacrifice of enormous capital, that has become a practical and commercial proposition."

Speaking of his own personal and practical experience, in the use of coalite, the residual fuel of low temperature carbonisation, Professor Wynne said that this fuel completely filled all domestic requirements and was certainly no more expensive than coal. The supply at present was not sufficient to meet the demand, but that would be altered, and he hoped to see the time when the burning of raw coal in domestic

grates, at all events in congested urban districts, would be made illegal.

"Can anyone doubt," he asked, "that with one-tenth of the public capital invested in our great municipal water supplies we could get our air as clean as our water is now?" The air was free but everyone had still a right to add to it poisonous and destructive impurities subjected only to very limited restraints, which were almost universally regarded as "a burden on industry," or, in the case of domestic smoke, would be resented as an interference with the "liberty of the individual" if any restrictions were introduced. The reiteration of these time-worn phrases was simply a symptom of mental inertia.

THE RAVAGES OF SOOT.

The damage done by the deposits of soot could be more accurately stated in the case of vegetable life than of animal life, and this had been done by Dr. A. E. Ruston, of Leeds University. In one of his experiments, hollyhocks from the same parent stock were grown in tubs of identical soil in different parts of the city. In the most polluted part of the industrial area during the second year of the experiment only one plant survived. It achieved a height of nine inches and failed to flower. In a comparatively smokeless area some miles north of the city a growth of eight feet was obtained with full flowering. The damage caused by soot, therefore, began with vegetation, and the consequent deterioration of our milk and meat supplies.

Speaking of the result of the conversion of the sulphuric content of coal into sulphuric acid, Professor Wynne said that our buildings were being eaten away and our household fittings and even our clothes (and especially our books) were gradually being destroyed. To this must be added the destruction of vegetation, the enormous waste of coal, and the lifelong toil of millions of women in unnecessary and soul-destroying tasks of perpetual washing and scrubbing to remove the effects of man's stupidity.

"No real advance," he declared," towards the abatement of our present habit of destroying life, health, beauty and wealth by the unscientific and deliberately wasteful combustion of coal in furnaces and domestic grates, can be made without intimate co-operation and intelligent determination on the part of the Legislature, the Government, the local authorities and their medical advisers, the engineers and architects, the public, and above all the great employers of labour and users of power."

NEW CEMENT DEVELOPMENT.

The demand for high-class Portland Cement is becoming more and more insistent and users will be interested in the modern Cement Works now rapidly nearing completion at Ketton, Rutland. Messrs. Thom. W. Ward, Ltd., Sheffield, whose activities in the iron, steel, and constructional trades are so well known, have a controlling interest in The Ketton Portland Cement Co., Ltd., which has acquired an estate in Rutland of 1,714 acres, including the famous Ketton Oolitic Freestone Quarries, and by July the works will be manufacturing high grade Portland cement at the rate of 60,000 tons per year.

From the Ketton Quarries stone has been taken for centnries and used in such buildings as the Tower of London, St. Dunstan's, Lambeth Palace, and many of the ancient buildings at Cambridge and in the more modern Peterborough and Ely cathedrals. The stonework at Sandringham House also came from these quarries. The Ketton Oolitic Limestone and Clays have proved ideal raw materials for cement when mixed in the right proportion and the supplies are almost inexhaustible and can be easily worked.

AN IMPORTANT BRITISH POWER STATION USING PULVERISED FUEL.

The most advanced steam-raising plant in the country fired with pulverised fuel on the direct-fired process is the Birchills, Walsall, Power Station of the West Midlands Joint Electricity Authority, which was completed during the latter part of 1928. The plant is extremely compact and is characterised by various important features. The whole of the design was supervised by Mr. E. M. Lacey, consulting engineer, of 12, Victoria Street, London, the main contractors being International Combustion, Ltd., of London and Derby.

The plant comprises three bent-tube boilers, supplied by John Thompson Water Tube Boilers, Ltd., each having a normal evaporative capacity of 60,000 lb. per hour with an overload capacity of 80,000 lb. The working pressure is 320 lb. per square inch. The heating surface of each boiler is 9,368 square feet. Each boiler is equipped with a "M.L.S." superheater and a Foster economiser, whilst the combustion air is preheated by means of an "Usco" plate type air heater.

The coal is pulverised by Raymond Impax mills and fed direct to the boiler. Each mill has a granding capacity of three tons

per hour, and there are two mills to each boiler. The raw coal after leaving the bunker passes through the type "R" rotary steam dryer and is carried to the pulverisers. In operation the pulverisers have given the greatest satisfaction, and Mr. Prentice, the resident engineer, states that wear and tear has been negligible, and that various samples of the ground product show that 90 per cent. of the coal pulverised in these mills passes a 200 mesh. The mills create very little noise in operation and the general cleanliness of the whole of the equipment is noticeable.

An important feature is the reduced dimensions of the combustion chambers. Each is fitted with a type "R" burner, which permits the combustion process and the length of the flame to be controlled with remarkable precision. By the use of this burner the cubical contents of the combustion chamber can now be very much reduced when compared with former practice. The combustion chambers have a cubic capacity of 5,390 cubic feet, the dimensions being 16ft. 8in., by 18ft., with a height above water screen of 22ft.

The raw coal is brought to the station in barges by means of the canal, and is unloaded by a grab crane into the yard, picked up as required by means of the grab and unloaded on to the belt conveyor of the Underfeed type, which transports it to the raw coal bunker or to the storage.

The coal is stored in the yard or alterna tively removed from stock on to the coal conveyor by means of the Beaumont cable drag scraper plant, as manufactured by the Underfeed Stoker Co., Ltd. This is the first of its kind to be put into operation in an English power station, and is a simple and effective apparatus with low operating cost and complete reliability.

The coal used at Birchalls is obtained from neighbouring collieries, and is small low-grade fuel, having a calorific value of approximately 9,500 B.Th.U.'s, and an ash content varying from 8 to 15 per cent. This is mixed with a certain proportion of higher-grade before use. The average cost at the colliery is 8s. 6d. per ton.

NINE MILLION GALLONS A YEAR SUPPLY OF PETROL AVAILABLE.

Scientist on New Hope for Coalfields.

"If Great Britain submitted the 180,000,000 tons of coal she consumes yearly to the low temperature distillation process, she could produce from it a minimum of 900,000,000 gallons of motor spirit," said Dr. H. B. Cronshaw, B.A., Ph.D., in a staff lecture at the Bussey Coal Distillation Institute, Regent Street, on April 5th.

"'At present," he said, "we consume some 900,000,000 gallons of motor spirit at a cost of £40,000,000. Even the utilisation of the 40,000,000 tons of coal, now burnt by the householder, for the production of 200,000,000 gallons of low temperature oil, would not only create a prosperous industry, but would challenge the present domination of trusts over prices and supplies, and might play a vital part in times of war.

"Some people," Dr. Cronshaw added, fear that the introduction of the low temperature process might create unemployment. Exactly the opposite is the case. More miners and a great many general workers would be required. Apart from oil and other such by-products, the process we operate produces a high-grade smokeless fuel, which, weight for weight, is higher in thermal efficiency than raw coal. Even if the process were adopted universally, the domestic hearth would still need its 40,000,000 tons of fuel. But 60,000,000 tons of raw coal would be necessary to procure this by low temperature distillation. There would, therefore, be an increase in the demand for coal to the extent of 20,000,000 tons—quite a substantial order. Something like 70,000 more persons would be employed at the mines to meet the demand, not to mention the workers required to operate the distillation retorts and to refine the oil and other by-products."

CATALOGUE OF PLANS OF ABANDONED MINES.

The Secretary for Mines announces the publication o fVolume II of the new Catalogue of Plans of Abandoned Mines. This Volume covers the Counties of Cornwall, Devon, Dorset, Gloucester, Kent, Somerset, Stafford and Worcester, and includes particulars, not only of the large collection of plans o fabondoned mines at the Department, but also of many plans in private ownership, information regarding which has been included by the courtesy of the owners.

In all it contains entries for about 4,000 plans, and it gives for each plan, so far as it has been possible to obtain the information, particulars of the coal seam or other mineral worked and data from which the approximate position and probable extent of the workings can be seen on the 6-inch scale sheets of the Ordnance Survey. It contains also a large number of references to aban-

doned mines the plans of which have not been found.

The primary object in preparing the Catalogue has been to assist those engaged in the mining industry in dealing with the problem of danger from accumulations of water and the other problems that may arise from the existence of ald workings in proximity to present-day workings. The Catalogue may be of service also to persons interested in mineral prospecting and development, and to others who, for various reasons, may be interested in the question of surface subsidence in particular localities.

Volume II of the Catalogue is now on sale, and copies can be obtained through any bookseller, or directly from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 120, George Street, Edinburgh. The price of the Volume, which has been fixed merely to cover the bare cost of printing, is 15s. net, 15s. 5d. post free.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY OF LONDON.

Wednesday, April 24.

The Geology of Part of North-Western Rhodesia. By ROBERT MURRAY-HUGHES, F.G.S., Assoc.I.M.M., with Petrographical

After defining the scope of the work, this paper goes on to describe the physical geography of the area, which lies approximately between lat. 14° and 17° S. and long. 24° and 30° E. The subject falls into three natural divisions, which follow each other roughly from west to east. The first is the flat, somewhat swampy country overlaid by the arroo and Kalahari rocks; the second is the old peneplain-surface forming the plateau of Northern Rhodesia and underlaid by the Transvaal and Pretoria rocks, and those of the Swaziland System; and the third, a deeply dissected country overlaid mostly by the Swaziland rocks and drained by the Zambesi and Luangwa rivers.

The Swaziland rocks, composed of gneiss, chlorite-schists, and kyanite-schists with various hornblendic rocks are described, and a short description is given of the Old Granite intrusive, and of the more recent dolerites. It is sugggested that the last named are of Karroo Age.

The following groups, named the Lusaka and Kafue Beds, and formed of calcareous, dolomitic, and quartzose rocks, are described, and a tentative correlation of them is made with the Transvaal and Pretoria Systems of the South. The Hook Granite forms one of the most important features in the geology of the country, and is shown to be intrusive into the Lusaka and Kafue Beds, which are strongly metamorphosed by it. It is normally a biotite-granite; but in contact with the older sedimentaries, it takes on the form of syenite, gabbro, perknite, etc. Dykes of quartz-porphyry and minette are the later manifestations of this intrusion.

The discovery of flat-lying grits and sandstones in the west are correlated with similar beds found in the Laungwa Valley, and those in turn with the Karroo Beds described and mapped by A. J. C. Molyneux in the south-eastern portion of the area.

The covering of sand in the west, together with certain 'ancient laterites,' is correlated with the Kalahari System.

A short attempt is made to indicate the principal structural features, these being divided into four groups :—

(1) The north-east and south-west foliation caused by the intrusion of the Older Granites.

(2)The north-west and south-east fracturing caused by the intrusion of the Hook Granite.

(3) The graben faulting, which forms a part of the Great Rift Valley.

(4) The folding of the Karroo Beds.

A few of the more important thermal springs are described, the widespread occurrence of laterite and its mode of development is indicated, and the paper concludes with a few brief remarks on the belts of alluvium.

INSTITUTION OF CIVIL ENGINEERS.

NEW MEMBERS.

The following elections of a member, associate members, transfers from associate members to members, have been made by the Institution of Civil Engineers :—

Member—Simons, C. B.

Associate Members — Adams, W. F.; Adlington, R. E.; Aitken, J.; Blackburn, J.; Boothman ,A.; Boulton, A. G.; Bridgwater, L. T.; Bromberg, H.; Chatterjee, B. N.; Collins, G. H. H.; Dean, A. J.; Eck, C. B.; Gibbons, F.; Gilbert, S. K.; Green, G. A.; Hardy, F. A.; Hebson, G.; Heesem, J. M.; Henderson, N. B.; Holden, D. E.; Horrocks, H. M.; Ingram, N.M.; Izatt, J.; Kenmuir, C. L.; Kennerell, E. J. R.; Lewis, B. E.; Mackay, I. M.; Matthews, J.; Paul, A. A.; Pearson ,H. M.; Rigby,

W. L.; Rodger, L.; Stokes, P. G. W.; Taylor, W. K.; Thompson, J. H. H.; Waddington, L. R.; Wyllie, R.

Transferred from Associate Members to Members—Amps, L. W.; Barton, G. B.; Braddock, H. A.; Frank, R. A.; Goodwin, C. J.; Legat, A. W.; Matheson, E. G. G.; Plunkett, A. L. B.; Timmis, F. W.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Monday, April 29, at 8 p.m.—(Cantor Lecture.) Sir E. Denison Ross, C.I.E., Ph.D., *Director, School of Oriental Studies*: "Nomadic Movements in Asia." (Lecture III.)

Wednesday, May 1, at 8 p.m.—(Ordinary *Meeting*.) P. Morley Horder, F.S.A.: "Architectural Models."

ROYAL INSTITUTION.

21, Albemarle Street, London, W.1.

Friday, April 26, at 9 p.m.—"English Civilisation from Alfred to Harold, 900—1066." By Professor R. W. Chambers, F.B.A.

Wednesday, May 1, at 5 p.m.—Annual Meeting.

Friday, May 3, at 9 p.m.—"The Garden Tulip." By Sir Daniel Hall, K.C.B., F.R.S.

SOCIETY OF PUBLIC ANALYSTS.

Wednesday, May 1, at 8 p.m., at the Chemical Society's Rooms. The following papers will be read:—

"The Determination of Organic Peroxides." By R. S. Morrell, M.A., Ph.D., F.I.C., and S. Marks, M.Sc., A.I.C.

"Differential Halogen Absorption of Oils and Fats." By J. W. Croxford. (Work done under the Analytical Investigation Scheme.)

"A New Method for the Separation of Small Quantities of Tantalum and Niobium from Titanium." By W. R. Schoeller, Ph.D., and C. Jahn. (Work done under the Analytical Investigation Scheme.)

"The Analysis of Small Samples of Gas." By H. R. Ambler, B.Sc., A.I.C.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

Gower Street, W.C.1.

DIARY OF PUBLIC LECTURES AND SPECIAL ARRANGEMENTS.

Monday, April 29.—Faculty of Laws: Third Term begins.

Monday, April 29, at 5.15 p.m.—"Drug-like Actions of Some Food Constituents." First of a Course of three public Lectures by Professor E. Mellanby, M.D., F.R.C.P., F.R.S., of the University of Sheffield. April 29, 30, and May 1. (Lantern Illustrations.) Chairman at the first lecture: Professor J. A. Gunn, M.D., D.Sc., of the University of Oxford.

Monday, April 29, at 5.30 p.m.—"Geometry: A Brief Review." First of a Course of three public Lectures by Professor H. F. Baker, Sc.D., F.R.S., of the University of Cambridge. April 29, May 7 (Tuesday), and May 13. Chairman at the first lecture: Professor G. B. Jeffery, F.R.S.

Tuesday, April 30, at 7.30 p.m.—Fellows' Dinner. Chairman: Professor F. W. Oliver, M.A., D.Sc., F.R.S.

Wednesday, May 1, at 5 p.m.—"Registration of Title to Land as a Humane Study." A public Lecture by Lt.-Col. J. S. Stewart-Wallace, C.B., D.S.O., Chief Land Registrar, H.M. Land Registry. Chairman: Sir Benjamin Cherry, Barrister-at-Law and Conveyancing Counsel of the High Court.

Wednesday, May 1, at 5.30 p.m.—"The Local Government Reform Scheme and Derating." A public Lecture by Mr. Geoffrey Peto, C.B.E., M.P. Chairman: Sir Frank Heath, G.B.E., K.C.B.

Thursday, May 2, at 5.30 p.m.—"Goethe's *Faust*." First of a course of three public lectures, in German, by Professor J. Petersen, of the University of Berlin. May 2, 9, and 16. Chairman at the first lecture: Dr. G. P. Gooch, F.B.A. (Lantern Illustrations at the third lecture.)

Friday, May 3, at 4 p.m.—"Some of the Sequels of Epidemic Encephalitis (Lethargica.)" First of a course of two public lectures by Professor A. J. Hall, M.A., M.D., F.R.C.P., of the University of Sheffield. May 3 and 10. (Lantern and cinematograph illustrations.) Chairman at the first lecture: Professor T. R. Elliott, C.B.E., D.S.O., M.D., F.R.S.

Friday, May 3, at 5.30 p.m.—A Public Inaugural Lecture by Dr. R. Robinson, F.R.S., University Professor of Organic Chemistry. Chairman: Professor J. Norman Collie, F.R.S.

THE FARADAY SOCIETY.

ANNUAL GENERAL MEETING.

The 23rd Annual General Meeting will be held in the Rooms of the Chemical Society on Thursday, 23 May, at 7.45 p.m.

New Patents

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

10,442.—Aktiebolaget Kemiska Patenter.—Manufacture of phosphoric acid, etc. April 4.

10,579.—Carpmael, A.—Manufacture of salts of antimonic acid., etc. April 5.

10,624.—Distilleries des Deux-Sevres.—Manufacture of acetic acid, etc. April 5.

10,696.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of alcohols. April 6.

10,503.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of concentrated titanyltitanic sulphate solutions. April 4.

Specifications Published.

308,859.—Slade, R. E., and Imperial Chemical Industries, Ltd.—Production of ethyl alcohol.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

FLORANOL.

500,004.—Chemical substances for use in the manufacture of perfumery.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. April 10th.

IXONA.

497,457.—Chemical substances prepared for use in medicine and pharmacy.—Mason's, Limited, 3, Pancras Lane, Queen Street, London, E.C.4. April 10th.

"CHEMICAL NEWS"—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—

MANAGER, "CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices: MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

Anti-Acid
Specialities!

"CONTRACITE"
Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL CXXXVIII. No. 3603.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES :
Administrative : Central 6521.
Printing Works : Hop 2404.

CONTENTS. PAGE.

The Collinsics of Minerals. XI. 273
By Hawksworth Collins, B.A.
Steam Generation Efficiency 275
By a Well-Known Engineer.
Influence of the Ammonium Ion on the Quinhydrone Electrode Potential 276
By M. Shikata and I. Tachi.
World's Largest Coal Distillation Plant 276
By Dr. H. B. Cronshaw, A.R.S.M.
History of Fast Dyes and Dyeing ... 278
By James Morton.
General Notes :—
Wholesale Prices in March 280
New Zealand Institute of Architects 280
British Exports, First Quarter, 1929 280
Exploitation of Volcanic Ash in Saskatchewan 281
Quicklime for Use in Distilling Ammonium 282
Canadian Geodetic Surveys 282
Correspondence :—
Fuel Reform 283
Proceedings & Notices of Societies :—
Society of Glass Technology 284
Royal Agricultural Society 285
Notices of Books 286
Forthcoming Events 287
New Patents 287
New Trade Marks 288

THE COLLINSICS OF MINERALS. XI.

By HAWKSWORTH COLLINS, B.A. (Camb.).

In the *Chemical News*, 1928, cxxxvii, 338, a list of the discoveries which gradually led up to the collinsics was given; and as 132 of the latter have now been published, it is possible, although they at present only concern 17 out of about 80 elements, to begin to give an idea of the truths which are becoming evident as a result of the discovery of the collinsics.

In the *Chemical News*, 1926, cxxxiii, 161, it was shown that the Relative Volumes of the Elements are the Fundatental constants of Nature. This is now corroborated by the fact that in 7 of the 17 elements concerned, the atomic optical refractivity in each case is a number which is exactly the same as a previously obtained atomic volume of the same element. These results are collected in the following table.

TABLE XIV.

Element	Atomic Rel. Vol.	Atomic Refractivity.	Number of times the pair has occurred *in the first* 132 Collinsics.
Na	11.865	3.865	57
K	22.29	7.49	13
N	3.8	3.8	4
Ca	13.25	13.25	17
P	14.56	10.51	44
Cu	9.54	14.77	24
Si	13.02	11.53	53

3.865 and 7.49 were published as the relative volumes of Na and K when forming constituent parts of an atom. The next two, N and Ca, have atomic refractivities exactly the same as their relative volumes, and this will later be shewn to be the case in many other elements.

There are many other coincidences with regard to O.R. and R.V. which will be mentioned later.

The R.V. of Cu here is 9.54, and the corresponding O.R. 14.77 in nine of the twelve minerals.

Two interpretations of the experimental facts with regard to Chalcanthite are given in Nos. 128 and 129, and another appeared in No. 74. These three interpretations are entirely due to great variations in S.G. and O.R., and the Theory of the Collinsics shows the causes of the variations. The word "theory" is not used here in the sense of "hypothesis," but in the meaning it holds in the phrase "The Theory of Quadratic Equations," *i.e.*, something which is seen to be exactly true, not surmised.

The first line of a collinsic gives the chemical formula of the mineral. The second gives the theoretical specific gravity, and the experimental S.G. The third line gives (between the brackets) the relative volume of each atom; and also the product obtained by multiplying the sum of these volumes by $\mu - 1$, where μ is the refractive index of the substance. The fourth gives the theoretical and also the experimental refractive indices. And the fifth line gives the sum of the optical refractivities of each atom.

TABLE XV.

THE COLLINSICS OF TWELVE MINERALS.

	Theor. Column	Obs. Column
(121) Gerhardtite $Cu(NO_3)_2.3Cu(OH)_2$	**3.40**	3.378 Wells 3.426 Wells
$Cu_4 + N_2 + O_4 + O_6 + H_6$		
$\mathbf{100.359 = 0.714(9.54_4 + 3.8_2 + 7.53_4 + 2.51_6 + 5.76_6)}$	**1.714**	1.703–1.722 D
$\mathbf{100.358 = 14.77_4 + 3.8_2 + 1.654_4 + 1.346_6 + 2.613_6}$		
(122) Malachite $Cu_2 + C + O + O_3 + H_2O$	**3.917**	3.9–4.03 D
$\mathbf{45.138 = 0.8036(9.54_2 + 8 + 7.53 + 2.51_3 + 14.03)}$	**1.8036**	1.655 S 1.909 S
$\mathbf{45.137 = 14.77_2 + 3.333 + 1.654 + 1.346_3 + 6.572}$		
(123) Turquoise β $Cu + Al_6 + P_4 + O_4 + O_{16} + 9H_2O$	**2.713**	2.70 D 2.73 M
$\mathbf{191.67 = 0.62574(9.54 + 9.05_6 + 14.56_4 + 4.45_4 + 2.51_{16} + 14.03_9)}$	**1.62574**	1.61–16.5 S
$\mathbf{191.672 = 14.77 + 7.865_6 + 10.51_4 + 1.747_4 + 1.346_{16} + 6.572_9}$		
(124) Azurite $Cu(OH)_2.2CuCO_3$		
$Cu_3 + C_2 + O_2 + O_2 + O_4 + H_2$	**3.805**	3.83 D 3.8 W
$\mathbf{68.389 = 0.7587(9.54_3 + 8_2 + 7.53_2 + 4.45_2 + 2.51_4 + 5.76_2)}$	**1.7587**	1.758 N_m W
$\mathbf{68.388 = 14.77_3 + 3.333_2 + 1.654_2 + 1.747_2 + 1.346_4 + 2.613_2}$		
(125) Erinite $Cu_5(OH)_4As_2O_8$		
$Cu_5 + H_4 + As_2 + O_2 + O_8 + O_2$	**3.992**	4.0 W
$\mathbf{139.75 = 0.844(9.54_5 + 5.76_4 + 19.58_2 + 7.53_2 + 4.45_8 + 2.51_2)}$	**1.844**	N_m1.86 W N_p1.82 W
$\mathbf{139.778 = 14.77_5 + 2.613_4 + 17.75_2 + 1.654_2 + 1.747_8 + 1.346_2}$		
(126) Pseudomalachite $(CuOH)_3PO_4$		
$Cu_3 + O_3 + H_3 + P + O_4$	**3.6**	3.6 W
$\mathbf{73.0012 = 0.7842(9.54_3 + 7.53_3 + 5.76_3 + 14.56 + 2.51_4)}$	**1.7842**	N_g1.807 W N_p1.73 W
$\mathbf{73.005 = 14.77_3 + 1.654_3 + 2.613_3 + 10.51 + 1.346_4}$		
(127) Langite $Cu_4SO_7.4H_2O$		
$Cu_4 + S + O + O + O_5 + 4H_2O$	**3.48**	3.48 D
$\mathbf{101.29 = 0.754(9.54_4 + 15.53 + 7.53 + 4.45 + 2.51_5 + 14.03_4)}$	**1.754**	N_m1.760 W N_p1.708 W
$\mathbf{101.249 = 14.77_4 + 5.75 + 1.654 + 1.747 + 1.346_5 + 6.572_4}$		
(128) Chalcanthite $CuSO_4.5H_2O$		
$Cu + S + O_2 + O_2 + 5H_2O$	**2.281**	2.284 15° CRPC
$\mathbf{59.5686 = 0.5458(9.54 + 15.53 + 4.45_2 + 2.51_2 + 14.03_5)}$	**1.5458**	1.546 S
$\mathbf{59.566 = 14.77 + 5.75 + 1.747_2 + 1.346_2 + 6.572_5}$		

		Theor. Column	Obs. Column
(129)	Chalcanthite $CuSO_4.5H_2O$		
	$Cu + S + O + O_3 + 5H_2O$	**2.258**	2.254 Play 2.263 Schr.
	$\mathbf{59.077 = 0.5357(9.54 + 15.53 + 7.53 + 2.51_3 + 14.03_5)}$	**1.5357**	1.53 - 1.539 N_m W
	$\mathbf{59.072 = 14.77 + 5.75 + 1.654 + 1.346_3 + 6.572_5}$		
(130)	Xonotlite $Ca_5 + Si_5 + O + O_2 + O_{12} + H_2O$	**2.7**	2.7 W
	$\mathbf{128.592 = 0.581(14.54_5 + 17.61_5 + 7.53 + 4.45_2 + 2.51_{12} + 14.03)}$	**1.581**	N_m 1.583 W
	$\mathbf{128.597 = 10.52_5 + 9.625_5 + 1.654 + 1.747_2 + 13.46_{12} + 6.572}$		
(131)	Cuspidite $Ca + Ca + F_2 + Si + O_3$ h	**2.98**	2.97 W
	$\mathbf{38.782 = 0.596(14.54 + 13.25 + 5.42_2 + 18.91 + 2.51_3)}$	**1.596**	N_m 1.595 W
	$\mathbf{38.789 = 10.52 + 13.25 + 0.26_2 + 10.461 + 1.346_3}$		
(132)	Mullite $Al_6 + Si_2 + O_5 + O + O_7$	**3.04**	3.03 W
	$\mathbf{89.685 = 0.64056(9.05_6 + 13.02_2 + 7.53_5 + 4.45 + 2.51_7)}$	**1.64056**	N_m 1.644 W N_p 1.642 W
	$\mathbf{89.689 = 7.865_6 + 11.53_2 + 1.654_5 + 1.747 + 1.346_7}$		

STEAM GENERATION EFFICIENCY.

The Science of Blending for Combustion.

By A Well-Known Engineer.

Equally important for the largest and the smallest boiler plants is the great attention now being given to the science of blending the coal or other solid fuel, both as regards preventing black smoke and reducing the fuel bill. The subject is of considerable importance because, for example, not only lower grade coal, but also all kinds of material, especially coke breeze from gas works and by-product coke oven plant, can be utilised on these lines, as well as residues from extractions of tannic acid, alkaloids, perfumes, foodstuffs, and similar products. The value of the general principle is well illustrated by an interesting series of trials carried out just recently at the works of a well-known firm of tar distillers in Lancashire using mixtures of coal at 17s. per ton and gas works coke breeze at 8s. per ton, a material easily obtainable under the circumstances. Essentially the plant consists of three 30′ 0″ × 8′ 0″ "Lancashire" boilers, feed water economisers, and superheaters, with "Turbine" forced draught furnaces, and the coal was 13,177 B.Th.U. per lb., with 5 per cent. ash and 21 per cent. moisture, being an extraordinarily good quality, while the corresponding figures for the coke breeze were 10,800 B.Th.U. per lb, 15 per cent. ash and 9 per cent. moisture.

The nett result was a substantial economy in nett cost of production of steam when using a blend of 1 : 2 coal and breez, or 1 : 3, as against 2 : 1 coal and breeze or coal only. Thus for example, the cost of evaporation of 10,000 lbs. of steam per hour with two parts coal and one part breeze, was 7s. 10d., whereas the figure for 1 : 2 coal and breeze was 6s., and 1 : 3 coal and breeze, 5s. 9d. In all cases the performance represented average industrial practice, 685-756 lbs. of fuel per hour with an average evaporation of 4500-5050 lbs. of water per hour in continuous daily running, the economisers, however, being of small size, using 85-95 lbs. of steam pressure and 470° F. superheated steam temperature. The thermal efficiency also is about 68 per cent., and under these circumstances the figure of one part coal and two parts breeze is now used regularly, since increasing the breeze beyond this point makes little difference, but of course with great saving as against the previous practice of coal only.

Incidentally, this is only another example of the much greater attention now being given to small steam and power plant, which

in the aggregate are much more important than power stations, for example, a fact not generally realised, the approximate figures in Great Britain being 90,000,000 tons of coal used per annum for steam generation, of which only 8,000,000 tons is absorbed by electrical power stations.

ON THE INFLUENCE OF THE AMMONIUM ION ON THE QUINHYDRONE ELECTRODE POTENTIAL.

By Masuzo Shikata and Isamu Tachi.

Since Biilmann (1921) proposed the applicability of the quinhydrone electrode to the measurement of hydrogen ion concentration (1921), this electrode has been used for pH measurement in technical as well as in biological problems.

The range of its applicability was also investigated by the same author and others (1927) and it was proved that it could be depended on to measure accurately even as small amount as 0.0005 volts in an acidic as well as in a slightly alkaline solution (under pH 8,5).

Sörensen (1921) and Lindström-Lang (1925) studied the influence of cations ($Li^{\cdot}$, $Na^{\cdot}$, $K^{\cdot}$, $Rb^{\cdot}$, $Cs^{\cdot}$) and anions (Cl', Br', I') on the quinhydrone electrode potential. The effect seems to be the salting out action of those ions.

O'Sullivan (1925) showed that the quinhydrone electrode could be employed in measuring the pH of solutions containing metallic ions such as copper, tin, lead and nickel. Biilmann (1921, 1927) too, proved that it could be applied also in the presence of nitrate and hypochlorite ions. Those phenomena are ascribed to the reducing action of the quinhydrone electrode being weaker than the platinum hydrogen electrode.

However, the present authors, in working with the quinhydrone electrode, found that the quinhydrone electrode did not give any stable potential in an ammonium salt solution, such as NH_4Cl. After 24 hours it even became more positive.

Moreover, it was observed that when quinhydrone was kept in an ammonium chloride solution, its colour changed to reddish brown, red, and at last reddish violet and after a few days, a flocky brownish yellow substance was seen on the surface of the solution and this changed to a black precipitate.

The acidifying effect of ammonium salts (sulphate and chloride) is ascribed to the interaction of quinhydrone with the ammonium radical, setting the acid free. The resulting product of the interaction was not isolated and it was impossible to determine whether it was a chemical compound or an adsorption compound.

The same reaction took place between quinhydrone and the ammonium salts of organic acids because the same change of colour as in the cases of sulphate and chloride was observed with those salts. However, in this case the change of potential was hardly recognisable owing to the buffer action of those salts.

In practice in the determination of pH with a quinhydrone electrode, the presence of the ammonium ion must be avoided as far as possible, and in an inevitable case the earlier reading after a definite time, say 5 or 30 minutes, must be taken because the reaction velocity is not to high, or it would be better to apply the hydro-quinhydrone electrode instead of quinhydrone.

This acidifying influence proved to be the interaction of quinhydrone with the ammonium radical resulting in the liberation of free acids.

Although the new compound, which was formed of quinhydrone and the ammonium radical was not isolated, the evidence of the formation of such a compound is discussed from several standpoints.

A method to avoid the effect of ammonium ions was also proposed.

—The Chemical Institute, Department of Agriculture, Kyoto Imperial University.

WORLD'S LARGEST COAL DISTILLATION PROCESS PLANT DESCRIBED.

By Dr. H. B. Cronshaw, B.A., Ph.D., A.R.S.M.

A description of the largest low temperature coal distillation plant in the world, now being erected at Glenboig, Glasgow, for the Bussey Coal Distillation Company, was given recently to a Press representative by Dr. H. B. Cronshaw, B.A., Ph.D., A.R.S.M., chief technical adviser to the company.

The plant, he stated, is not an experiment. It is the outcome of several years' experiment and three years' successful working of two full-sized commercial units at Louisville, Kentucky, U.S.A. It will have a throughput of 500 to 600 tons of coal per day and a daily output of approximately 300 to 400 tons of smokeless fuel (semi-coke), 15,000 gallons of crude oil and 15,000,000 cubic feet of gas.

The Bussey retort consists of a vertical, brick-lined steel shaft that is internally heated. Its general form is that of a truncated cone of oval cross section, the full section of which is occupied by a grate. The grate is hollow and divided into sections, through which air, gas and steam in controlled amounts are injected into the base of the charge. Immediately above the grate is the discharge mechanism, which consists of a hollow water-covered cast steel cutter-bar, which, moving backwards and forwards across the grate, pushes off the coke from either end, in a form convenient for immediate use in the domestic grate. The products of the distillation are removed from the top of the retorts by an exhaustor.

Operation of the retorts is simple. Combustion is maintained within the charge at its base by injecting the required amounts of air, gas and steam through the grate. The rates of feed and discharge are under control, and are coddelated so as to keep the retort chamber filled at all times. Additional control is maintained by the varying suction at the top and the pressure at the base. The operator's chief duty is to watch the instruments recording the temperatures and pressures at various points within the retort.

The charge within the retort chamber may be considered as divided into three zones which merge into each other. In the top zone the incoming coal is heated to about 150° C. (300° F.) by the gaseous products from below, and some condensation of the oils takes place. The condensate is carried down by the charge, partly re-vapourised, and again swept upwards to the gas outlet. Meanwhile the heavier fractions are carried by the charge into the second zone, where the temperature range is between 150° C. and 425° C. (300° F. and 800° F.) and which may be looked upon as the distillation zone proper. Thirdly, the bottom zone is where the hardening or setting of the carbon residues takes place and where the reduction of its volatile content is brought to the desired point. This is also the zone of combustion, in which gas and air are burned to supply the heat necessary to carry on the process.

It is clear, Dr. Cronshaw added, that so far as the distillation process is concerned, the conditions of cracking are absent and that cracking cannot take place to any appreciable extent because, firstly, the temperature of the oils is never raised beyond the temperature of vapourisation, and, secondly, gases always move from the warmer to the cooler parts.

One of the most interesting features of the Bussey process is that tests with a full-sized retort show that good coke can be made from most cannel and other coals usually classed as non-coking; in fact, by modifying the conditions of operation all sizes and grades, from slacks and duffs to run-of-mine, can be successfully treated.

The yield of crude oil varies from 20 gallons to 40 gallons per ton of bituminous coal charges, and a yield of approximately 30 gallons may be expected from any fair grade of high volatile bituminous coal. It was found that cannel coal gave yields of 50 to 100 gallons per ton of coal charged.

An average coal may be expected to yield between 20,000 and 30,000 cubic feet of gas per ton, and its calorific value is about 250 British thermal units per cubic foot. Bussey gas is adapted for industrial heating and it may readily be converted through the medium of modern gas engines, into cheap power.

The Glenboig plant will consist of a battery of 14 retorts, each with a throughput of 50 tons a day.

NITRIC ACID.

The nitric acid industry in Japan is contemplating whether to continue its old process of distilling Chili nitre and sulphuric acid or to adopt the oxidation process of ammonia. The amount of the production of nitric acid is difficult to calculate, but according to Mr. Shunichi Uchida it is estimated at about 20,000 tons per annum as 100 per cent. acid, and its use is as follows:

For explosives	30 per cent.
,, celluloid	29 ,, ,,
,, dyes	22 ,, ,,
,, other uses	19 ,, ,,

Nitric acid is generally manufactured in the factory where the acid is used as the raw material, and its manufacture is by distilling Chili nitre and sulphuric acid by the various stills such as Guttmann's, Valentiner's and others.

SHIPBUILDING IN MARCH QUARTER.

According to Lloyd's Register Shipbuilding Returns, there was an increase of 114,500 tons in vessels under construction in the United Kingdom at the end of March, as compared with the close of last year, but this was 88,000 tons less than at the corresponding time in 1928. Tonnage under construction abroad was 105,000 higher than at the end of December.

HISTORY OF THE DEVELOPMENT OF FAST DYEING AND DYES.

By JAMES MORTON.

Paper read before the Royal Society of Arts, February 20.

(*Concluded from page 267.*)

But our "duckling" is only at the beginning of its hatching. The latest product from it is Alizarine Red (Turkey Red) by a new process from parachlor-benzoyl-benzoic acid, a derivative of phthalic anhydride. This red is the purest of its type that has yet been made, and a plant for its production of about 20 tons a week is now in operation. Another product about to be produced is benzoic acid of a very high purity, and phthalic anhydride is also now beginning to be used in this country for the manufacture of condensation resins for electrical work, and its uses in other directions keep ever on the increase. We are now making many tons a week of this beautiful crystal phthalic anhydride for our own use and general sale, and the plant is about to be doubled.

But I must now refer to another product whose growth was specially nurtured during that adverse year till it ripened and fell into our harvest basket to brighten an otherwise gloomy autumn. I refer to Caledon Jade Green, a product by which Scottish Dyes has perhaps become better known than by anything else we have done. But that was not the result of a day or a year. As users before the War we always felt much the want of a green of pure quality for our *Sundour goods*, and early in the days of our dye-making, and as soon as we had Research Chemists of our own, I determined we should have a hunt for such a green. It was one of the obvious blanks of the Vat palette, for we had pure blue, yellow, purple and red, and I somehow felt that somewhere amid that maze of compounds a green such as was wanted was lying buried. It was a vast field that had to be explored, and we knew it must be a long and tedious road. or over four years one or more of our Chief chemists and assistants were engaged mainly on this quest. Long periods there were of blank sterility, but ever and again little crops of verdure would give indications of something coming only to be left behind again and the hunt restarted. Till at last on the 11 September, 1920, the chemists came triumphantly to me with the first few grammes of the beautiful green colour that has not changed since, and that has indeed made history for itself and Scottish Dyes. It was somewhat bluer in tone than one had hoped for, but a beautiful Jade, and it was there and then christened, and has ever since been known as "Caledon Jade Green."

The Provisional Specification was filed on 27 November, 1920; the complete patent was granted on 29 May, 1922, the British number being 181,304, and the Jade Green Patents over the world number 22 in all. Briefly, it is produced by oxidising dibenzanthrone to the hydroxy-derivative by means of manganese dioxide and sulphuric acid, and this is then methylated with dimethyl sulphate to give the Caledon Jade Green. Plant for its manufacture was immediately erected both here and in America, and in a short time it had made a place for itself second to none in the Vat range. But why was it so important a colour that it should make such an immediate impression in the dye trade? Because not only was it the only pure green of the Anthraquinone Vats, but it was found to be the fastest all-round colour of the whole Vat series.

We learned shortly after it was on the market that the German Dyemakers had adopted it in their laboratories as their new standard for all-round fastness—a tremendous honour to a new and foreign made colour. Perhaps no achievement up to that time had so convinced the Germans that British Dyemakers were now a factor to be reckoned with.

But this colour was patented in Germany and they could not produce it. What would happen we sometimes wondered, for we knew they could not ignore the advent of a colour so outstanding as that Jade Green. In due time diplomatic soundings came, and in further due time these developed into something which may almost be called historic. For these negotiations led to a visit to us in the North of three of the Chiefs of the Badische Company of Ludwigshafen to discuss terms for the production by them in Germany of our Caledon Jade Green.

That was on the 3 July, 1925. I am frank in saying that we took the visit as a great compliment for it was the first time I know of in at least half a century that representatives of a Germany Company had come to Britain on such an errand. They were not easy negotiators, but we had a most friendly meeting, and at last the conditions were adjusted to the satisfaction of all parties. And now comes in the sequel to the incident which I gave you in the first chapter of my story. For you must remem-

ber that these three gentlemen were from the same Company that I had visited in the autumn of 1913. So when everything had been properly adjusted and documents signed, and we were indulging in more easy talk, I recalled to my friends in a chaffing way the incident I have already mentioned to you, and Dr. Bohn's jocular suggestion of placing my bust in the vacant niche in their Hall of Honour. "What about that bust now" I chaffed them, "surely the Jade Green justifies the honour." Their spokesman looked at me somewhat seriously. "Bust!" said he, "do you know, Mr. Morton, when we read your specification for that Jade Green we were so wild we had failed to discover it ourselves that we could have 'kilt' you." But they were most complimentary all the same, and in order to be quite fair on our side, I want to relate here that the collaboration with that Company over this colour led to a suggestion on their part for an improvement in one of the stages of manufacture that has enabled us to produce it at considerably less cost, and has given the colour a much wider field of usefulness. In this both parties benefited. As to the importance of the colour, I think it will not be questioned if I make the statement that it is the most outstanding discovery in the Dye trade since the introduction of the first Vat dyestuffs a quarter of a century ago. For this Jade Green is the fastest green made anywhere to-day. It is perhaps the fastest colour made anywhere. It has been on the market only a few years, and though I have not quite full data to verify it, I am going to venture the statement that of this Jade Green there is a bigger tonnage being made in the present year between here, America, and Germany than the total tonnage of all the Vat colours put together in the year before the War. And the research and discovery of that epoch-making colour was all done in the little Laboratories in Carlisle.

But I feel that you must have had more than enough of the details of a dye works. Before closing the catalogue, however, I want to refer to just one other phase because I know it is one that is sure to loom largely in the future. For the most part my remarks have made reference to Vat colours, and in one's mind one always considers them in their relation or application to cotton or vegetable fibres only. This is owing to the fact that except in a few cases the amount of caustic soda necessary for the dyeing of these Vats makes them inapplicable to wool or natural silk, as the caustic destroys or tenders the fibres to a very great extent. It has always been a dream of the manufacturer to get the use of these fast colours for wool and natural silk, and the trade has been waiting in expectancy for its realisation ever since the introduction of the Vat colours. In our textile laboratories we have spent much labour and research over this problem for several years. It was obvious that if these Vat dyestuffs could be got soluble in water, and could thereby be applied direct to the fibre without vatting in an alkaline bath, the desired end would be attained. This is a research I caused to be instituted in our textile dye laboratories some years ago, and in August, 1924, we were at last successful in finding a suitable process for rendering these anthraquinone vat dyestuffs soluble in water. This process was at once handed over to Scottish Dyes to develop on a manufacturing basis, and in January, 1925, we issued from our works at Grangemouth, Caledon Jade Green in a soluble form as the first of what we called the "Soledon Dyestuffs."

This was the first anthraquinone vat dyestuff to be put on the market by any firm in a soluble form. A few months previously a Swiss firm had put indigo on the market in a soluble form under the name of Indigosol, but it was by a different process of manufacture, and they have confined their commercial activities so far, with perhaps one exception, to the production of soluble Indigoids or closely related compounds.

This is a development that is now going on at Scottish Dyes in a vigorous way, and has very great potentialities. It is a problem, so far as Anthraquinone Vats are concerned, that has been lying to be solved for many years, and I am sure in times to come it will be one of the main claims to distinction attaching to the chemists of this country at this time—that the long looked-for solution has come from the chemists of these two British concerns—Morton Sundour Fabrics and Scottish Dyes. It is difficult to prophesy, but I do not think I should be far from the mark if I hazard the statement that in ten years' time all the so-called Fast Vat Colours will be used mainly in this soluble form on cotton and other vegetable fibres as well as wool and natural silk, and I shall be much surprised also if they are not all, or mainly all, made by the new and simple process developed and fully patenten in all country by our two companies.

I want to record here the splendid support given to all this work from its very in-

ception by the chemists and engineers of the concern. They began a very small band indeed, but they were loyal to the venture, and those who were there at the first, some fourteen years ago, are there to-day. We have not had cause to dispense with the services of a single chemist through all those years, nor has one left us, though several tempting offers have come their way. It has been a band of everincreasing strength, working in the friendliest co-operation and loyalty under Dr. Thomas, their head. We have had to mourn the loss through death of two young chemists, one of them A. H. Davies, a scientist of great ability and promise. And we have been lucky during most of these years in the official co-operation of Sir William Pope, of Cambridge, whom we look upon as the father of our team, while for an even longer period we have had the countenance and constant interest and encouragement of Professor Armstrong, our Chairman to-night, whom we may call the grandfather of the family. His visits, of a purely friendly interest, in the early days were a source of great help and inspiration, which I should wish to put on record.

In these more recent days we have all been adopted and become part of a much larger family, for we were considered worthy of being included among the group which now forms the great Imperial Chemical Industries, and while we continue our own activities and carry on along the old lines, we bask in the beneficence of the big chemical sun, and I see no reason why under it we should not produce fruits more precious and plentiful than ever in the past. For research is made more jossible, and, what is most important, the fruits of research are capable of immediate realisation by reason of that great Bank on the River Thames.

GENERAL NOTES.

WHOLESALE PRICES IN MARCH.

Board of Trade Index Number.

As measured at the Board of Trade, the general average of wholesale prices in March was higher by 1.2 per cent. than in February, the index numbers for the two months being 84.3 and 83.3 respectively (1924 = 100). The averages for food and for industrial materials show increases of 1.0 per cent. and 1.5 per cent. respectively. Cereals cheapened by 1.2 per cent., meat and fish became dearer by 1.0 per cent., and miscellaneous foods were, on the average, dearer by 3.0 per cent., comparing prices in March with those in February. An average advance of 0.4 per cent. was recorded in iron and steel prices, and one of 6.9 per cent. in those for other metals and minerals, the most important element in this advance being the increase in the quotations for copper and materials containing copper. For the cotton group, a rise of 1.9 per cent. is shown, while other textile materials and miscellaneous materials fell by 0.6 per cent. and 1.2 per cent. respectively.

NEW ZEALAND INSTITUTE OF ARCHITECTS.

H.M. Trade Commissioner at Wellington has forwarded a copy of the Journal of the New Zealand Institute of Architects. The Journal, which contains an interesting article concerning the desirability of architects giving consideration to the claims of British goods to preference when specifying or selecting materials and fittings for buildings, can be consulted by British firms interested on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

BRITISH EXPORTS, FIRST QUARTER OF 1929.

Coal.

In the first quarter of this year our exports of coal were slightly greater than in the preceding quarter and as much as 9 per cent. greater than in th efirst quarter of 1928. This latter increase was largely due to the greater quantities sent to France, which country accounted for 3,010,000 tons last quarter, compared with 2,306,000 tons in the first quarter of 1928. There were also substantial increases in the quantities shipped to Belgium, Italy and Scandinavia, Belgium taking 167,000 tons more (an increase of 50 per cent.), Itally taking 167,000 tons more (an increase of over 10 per cent.), and Sweden, Norway and Denmark together taking 232,000 tons more, an increase of nearly 25 per cent. compared with the first quarter of 1928, though some 20 per cent. below the level of the first quarter of 1927. Exports to the principal South American countries in the last quarter were, however, considerably below the level of a year ago. As regards the character of the coal exported, it may be observed that the greatest proportionate increase, compared with a year ago, took place in the exports of anthracite, which amounted to 799,000 tons last quarter, compared with 518,000 tons in

the first quarter of 1928. The average value per ton of all coal exported was 15s. 9d. in the first quarter of 1928, 15s. 6d. in January, 1929, 15s. 8d. in February and 16s. 1d. in March.

The quantity of coal shipped as bunkers for vessels in the foreign trade last quarter was about 3 per cent. smaller than a year ago, while the quantity of oil fuel so shipped was 7 per cent. greater. Imports of refined petroleum were substantially greater in the last quarter, motor spirit being responsible for the greater part of this increase.

IRON AND STEEL.

British exports of iron and steel and manufactures thereof, at 1,151,000 tons, were practically double the weight of the retained imports. The total was 92,000 tons (nearly 9 per cent.) greater than in the first quarter of 1928, this increase being about equally divided between crude iron and steel (chiefly pig-iron and ferro-alloys), and semi-finished rolling mill products. Exports of finished iron and steel goods accounted for 737,000 tons (64 per cent. of the total), a year earlier. The fact that the exports of the finished goods show little increase is mainly due to the shrinkage in the exports of railway material, which were exceptionally heavy in the first quarter of 1928. Exports of galvanised sheets showed a substantial increase in the latest quarter, and there were also satisfactory increases in the latest quarter, and there were also satisfactory increases in most sorts other than railway materials.

AMMONIUM SULPHATE.

Exports of cement and ammonium sulphate showed considerable increases last quarter in comparison with either of the earlier quarters. On the other hand, there were substantial decreases in the exports of sodium compounds, of leather, of boots and shoes, and of woollen and artificial silk stockings and hose. The increase in exports of tin blocks, etc., as compared with a year ago, was largely due to increased consignments to the United States.

COTTON PIECE GOODS.

Exports of cotton piece-goods last quarter amounted to 1,039 million square yards, which was very slightly below the level of the first quarter of 1928, but well above the rate for the whole of that year, when exports aggregated 3,867 million square yards. The reduction compared with a year ago occurred mainly in unbleached and printed goods, while exports of bleached goods increased substantially. It is of interest to note that our exports of unbleached cloth to Switzerland, Germany and other European countries with well-established cotton-finishing, etc., industries fell off very substantially compared with the first quarter of 1928, the exports to Switzerland alone falling from 43 to 21 million square yards.

MACHINERY AND SHIPPING IN FIRST QUARTER OF 1929.

Exports of machinery in the first quarter of the year were maintained at about the level of the preceding quarter, which is satisfactory in view of the fact that in 1928 our exports were substantially greater than in preceding years. Last quarter we exported about 3,000 more motor cars and chassis than a year earlier, though somewhat fewer than in the preceding quarter. This increase was mainly due to our shipments of complete touring cars to the Irish Free State being doubled (1,466 against 668), and to a recovery in our exports of chassis to Australia (2,538 against 1,537). Retained imports of motor cars and chassis were greater than a year ago, but less than in the preceding quarter. Exports of motor and other cycles showed satisfactory increases compared with a year ago.

The tonnage of ships and boats (other than war vessels exported was maintained at the high level of the preceding quarter. The value of all new ships and boats exportedported was £3,838,000 last quarter, compared with £2,188,000 in the first quarter of 1928. It is interesting to observe that the value of steam vessels exported increased from £1,001,000 to £3,053,000, while motor vessels fell off from £485,000 to £151,000, and war vessels from £643,000 to £577,000.

EXPLOITATION OF VOLCANIC ASH DEPOSITS IN SASKATCHEWAN.

Exploitation on a large scale of volcanic ash deposits in the vicinity of Swift Current, Saskatchewan, is to follow the installation there of a large mill by the Van Kel Cleansers, Ltd. This company has been engaged in extensive research work with the assistance of the Dominion and Provincial Governments and the University of Saskatchewan for the past three years, during which time production has been on a limited scale. The new mill building has been completed and machinery is being installed by the Kipp Kelly Co., Ltd., of Winnipeg.

The new industry represents an interesting use of Saskatchewan's mineral resources, volcanic ash or volcanic dust or pumicite

being an important abrasive and filler and purifier used in the manufacture of soaps and cleansers; polishes; as a woodfiller; in paints; and as a purifier for lard and tallow. The deposits are reported to be very large and the Company in addition to supplying Canadian trade requirements in volcanic dust will carry on the manufacture of cleansers, polishes, kalsomine, etc.

QUICKLIME FOR USE IN THE DISTILLATION OF AMMONIA FROM AMMONIA LIQUORS OBTAINED IN COKE AND GAS MANUFACTURE.

(*Abstract from U.S.A. Bureau of Standards Circular No. 373.*)

Quicklime is used in the distillation of ammonia in two ways: (1) In the concentration of the crude ammoniacal liquors, and (2) in the distillation of concentrated ammonia liquors to produce ammoniacal products. For these purposes the quicklime should slake to form a product of which not less than 95 per cent. will pass a No. 50 sieve, and not more than 10 per cent. will be retained on a no. 200 sieve. The available lime content should be 90 per cent. or more, based on the non-volatile portion of the material.

Testing.

(*a*) Available Lime.—Place 1.4 g of the carefully prepared and finely ground (passing a No. 100 sieve) quicklime in a 400 ml beaker, add 200 ml of hot water, cover, heat carefully, and then boil for three minutes.

Cool, wash down the cover, add two drops of phenolphthalein and titrate with normal hydrochloric acid, adding the acid dropwise as rapidly as possible, stirring vigorously to avoid local excess of acid. When the pink colour disappears in streaks retard the rate of addition of acid somewhat, but continue until the pink colour disappears entirely and does not reappear for 1 or 2 seconds. Note the reading and ignore the return of colour.

Repeat the test, substituting for the 400 ml beaker a 1 litre graduated flask carrying a 1-hole stopper fitted with a short glass tube drawn out to a point. Cool and add dropwise with vigorous stirring 5 ml less acid than before. Call the number of millilitres used " A." Grind up any small lumps with a glass rod slightly flattened at one end, dilute to the mark with freshly boiled distilled water, close with a solid stopper, mix thoroughly for four or five minutes, and let settle for half an hour.

Pipette a 200 ml portion, add phenolphthalein and titrate slowly with half-normal hydrochloric acid until colourless on standing one minute. Call this additional number of millilitres of acid " B." Then, the per cent. of available lime in the sample as received is 2A+5B. Calculate this result to the non-volatile basis using the data from (*c*).

(*b*) *Fineness.* — Determine fineness of quicklime as folows: Thoroughly slake the lime by adding 100 g of the laboratory sample to 500 ml of water. Stir the mixture slowly until the violent evolution of heat has ceased. Stir six times during the next 24 hours. Slow stirring for two minutes at each of the six times is recommended.

Strain the resulting milk of lime through a standard No. 50 sieve nested above a standard No. 200 sieve. Wash the residues on the No. 50 sieve thoroughly until the water passing into the No. 200 sieve is clear. The No. 50 sieve may then be removed and the No. 200 sieve washed in a similar manner. Washing may be considered complete when the water passing through the sieve is clear, but washing should not be carried on for over 30 minutes.

Dry the sieves containing the residues to constant weight in an oven at a temperature of 110 to 120° C. The residues on each sieve may then be removed and weighed, thus obtaining the per cent. retained on each sieve. Add the weight remainiug on the No. 50 sieve to that remaining on the No. 200 sieve to obtain the total residue on the No. 200 sieve.

(*c*) Non-Volatile Matter.—Weigh out a 1 gr. sample and ignite to constant weight at approximately 1,200° C. in a platinum crucible. The weight of the material left is the weight of the non-volatile matter.

PROGRESS OF GEODETIC SURVEYS IN CANADA.

A review of the work of the Geodetic Survey, Department of the Interior, for the past few seasons indicates how this branch of the Federal Government aids industrial development by supplying accurate information as to latitudes, longitudes, and elevations above sea level of selected points in all parts of the Dominion. With regard solely to the accurate fixing of position which constitutes the major portion of geodetic survey work, the geodesist selects suitable points and ascertains where they are on the earth's surface and their relation to and distance from one another. This

geodetic method of accurately ascertaining position is called triangulation. What lies between the selected points—rivers, lakes, arable lands, mineral lands, roadsteads, harbours, and the rest—must be plotted in by the topographical, geological, or hydrographic surveyor.

One of the first duties of the Geodetic Survey was the running of a network of points across Canada in the proximity of the International Boundary. In this it co-operated with the United States Coast and Geodetic Survey, and now a geodetic net extends along the border from the Atlantic to the Pacific and up the Atlantic coast to the southern boundary of Alaska.

While this operation was in progress Canada's industrial development was rapidly proceeding and railway, mining, and water-power enterprises were entering new areas. This increased the demand for important data as to latitudes, longitures, and altitudes which it is the function of the Geodetic Survey of Canada to furnish. In laying out the program of work these developments were fully considered and surveying was done in different parts of Canada to meet the most urgent demands. A bird's-eye view of the operations of the past few seasons and those immediately in hand is instructive as showing that many names which occur in the Geodetic Survey program are those to which the eyes of the country are directed by reason of developments now proceeding.

Much work has been done in the Maritime provinces. In the past few seasons this has been chinefly in southwestern Nova Scotia and northern New Brunswick; from the latter area the net enters Quebec by way of the Matapedia valley. The St. Lawrence valley has been dotted with triangulation stations from the strait of Belle Isle to Montreal. A triangulation net has been run along the transcontinental line of the Canadian National Railways from the St. Lawrence to the western boundary of Quebec, embracing the whole of the Rouyn district and connectinw with the net running up the Gatineau valley from the Ottawa.

From the Quebec-Ontario boundary the names that occur in the westward-extending net are Kirkland lake, Abitibi, Kamiskotia, Sudbury, and Nakina. The last named is on the transcontinental line of the Canadian National Railways about 260 miles west of Cochrane. This brings the work into the broken country about lake Nipigon wherein occur such familiar names as lac Seul and Red Lake.

SIR OLIVER LODGE ON METALS.

Sir Oliver Lodge, F.R.S., is to deliver the Nineteenth Annual May Lecture before the Institute of Metals on Tuesday, May 7. The title of the Lecture: "Some Ideas about Metals," is sufficiently broad to enable Sir Oliver to give one of his characteristic and enlightening discourses. Cards of invitation to the lecture can be obtained by means of a stamped and addressed envelope sent to Mr. G. Shaw Scott, M.Sc., Secretary of the Institute of Metals, 36, Victoria Stieet, London, S.W.1.

The next election of Members of the Institute, covering the period ending June 30, 1930, is due to take place on May 7; particulars of membership may be obtained from the Secretary.

BOARD OF TRADE ANNOUNCEMENT.

Dyestuffs Industry Development Committee.

The Board of Trade, on the nomination of the Association of British Chemical Manufacturers, have appointed Mr. J. Davidson Pratt, O.B.E., M.A., B.Sc., F.I.C., to be a member of the Dyestuffs Industry Development Committee in the place of the late Mr. W. H. Dawson.

CORRESPONDENCE.

FUEL REFORM.

(*To the Editor of the* CHEMICAL NEWS.)

Sir,—This is a time when political leaders of all shades of opinion are formulating policies designed to stimulate industry and create employment. May I be permitted to express the hope that, as a means to that end, a comprehensive and practical programme of fuel reform will be one of the chief aims of our next Government?

Statesmen, scientists and economists are agreed that coal must for many generations continue to be the foundation of British industry; but no one seems yet to have evolved a really comprehensive policy for the scientific utilisation of coal and the co-ordination of the various new fuel industries to which it would give rise.

In the exemption of British-produced oil and motor spirit from the petrol tax, the Government has taken a commendable step forward, and Mr. Churchill is to be congratulated on maintaining this policy in the Budget now before Parliament. As a result of this exemption there have been, within my own knowledge, during the short space

of twelve months, the following notable results :—

(1) At the works of Low Temperature Carbonisation, Ltd., at Barugh, Yorks, where about 30,000 gallons of crude oil and 3,000 gallons of petrol are produced weekly by the distillation of coal, a modern petrol recovery plant has been installed to increase the petrol output.

(2) Similar up-to-date plant is being erected at new Low Temperature Carbonisation works at Askern, now nearing completion, where 600 tons of coal will be distilled daily, and 100,000 gallons of crude oil and about 12,000 gallons of petrol will be recovered weekly.

(3) Capital to the extent of £470,000 has been found for the establishment of oil refineries at Killingholme, on the banks of the Humber, where the British-produced coal oils will be "cracked" into motor spirit and fuel oil, the latter being available for the Admiralty tank farm adjoining.

These figures speak for themselves. I venture to suggest that a properly coordinated plan of financial encouragement of fuel reform, in the shape of an oil subsidy or guaranteed loans for carbonisation plants would ensure the simultaneous development of (a) a great smokeless fuel industry; (b) a British coal-petrol industry; and (c) the use of oil-electric transport by road and rail, and of British-made bunker oils in ships.

I am Sir,
Yours faithfully,
W. A. Bristow,
Consulting Engineer.

39, Grosvenor Place,
London, S.W.1.
22 April, 1929.

Proceedings and Notices of Societies

SOCIETY OF GLASS TECHNOLOGY.

Annual Meeting.

At the Annual General Meeting held in Sheffield on April 17, 1929, Mr. Herbert Webb, of Stourbridge, was elected President in the place of Mr. Walter Butterworth, Senr., M.A. The following other officers were elected to fill vacancies due to retirement, namely :

Vice-Presidents—E. A. Coad-Pryor, B.A., C. J. Peddle, M.B.E., D.Sc., F.I.C.

Members of Council—F. F. S. Bryson, M.B.E., M.A., B.Sc., F.Inst.P.; H. W. Howes, M.Sc.Tech.; S. English, D.Sc., F.I.C., F.Inst.P.; E. Jobling-Purser; V. H. Stott, M.Sc.; Christopher Wilson.

The following officers were re-elected :—

General Treasurer—Joseph Connolly;

American Treasurer—F. C. Flint, B.S.

Hon. Secretary—Prof. W. E. S. Turner, O.B.E., D.Sc., F.Inst.P.

Auditors—C. S. Davey, Dennis Wood, M.B.E., F.S.A.A.

At the Ordinary General Meeting which followed the Annual Meeting, Mr. Walter Butterworth, Senr., M.A., delivered an illustrated lecture, his subject being :—"Glass : Cut and Engraved."

Mr. Butterworth outlined the history and development of the various modes of decorating glass throughout the centuries in many countries. The ancient Egyptians, skilled in the art of cutting and engraving gems and precious stones, readily applied their art to the decoration of glass when it was discovered. The scarabs and seals were carved cameo-fashion on the upper surface and the under side was decorated with intaglio. Cameo advanced, while intaglio fell away in popularity.

The vases and cups so greatly in vogue in the early Christian era were copied in glass, and glass carving at this time reached its zenith.

The Barberini or Portland Vase stands out among the famous Roman vases or cups. Numerous fragments and several vases of this style are still in existence. The Naples Amphora and the Auldjo Vase are still notable examples.

Illustrations of another style of decoration, the diatretum style, are found in the Situla of St. Marks, the Rothschild Vase, and the Strasburg Cup. These beautiful specimens were ornamented by a retimulation of glass rings almost detached from the vessel itself. Tiny glass rods, the only attachments, were left from the undercutting.

The Emperor Constantine transferred skilled glass and gem engravers to Byzantium, and there are relics of this work still guarded in certain churches, such as San Marco.

Even in Roman times the lapidary's wheel was employed for cutting blown or moulded vessels. The brilliance of the glass was enhanced by the cutting, without sacrificing the grace and beauty of the blown shape.

Hedwig glasses, to be seen in Breslau, Berlin, Amsterdam and several other places are supposed to date from the twelfth or thirteenth century, and scholars differ as

to their origin, which may be German, Byzantine, or East European. The conventional decorations stand out in high relief, the work of a coarse wheel.

The earliest engraving was done by a diamond or flint point. Its origin is not known, and the early examples are of great value. During the Venetian period a great revival took place. Sometimes the cutting and engraving were mingled with gilding and painting, and the grace of arabesques was also added.

At its best in the Renaissance period, Venetian glass decoration was subordinated to the sense of simplicity and balance. After the sixteenth century the main cutting and engraving passed to Germany and Bohemia. Many Venetian glasses were engraved in Germany long after their creation. Often in Germany the decoration and not the glass was the main object.

"Stipple," or "pointillisme" was a type of engraving which produced delicate, and apparently evanescent pictures which became visible only as the vessel was turned about. This style lasted to the nineteenth century, many specimens being of great charm and delicacy.

In the eighteenth century England followed the fashion of France in the cutting of glass lustres, candalabra, etc.

Following the introduction of coal fuel for glass furnaces, English glassmakers produced the new type of glass containing lead oxide, and the distinctively English cutting, to break up light into its many coloured constituents became very popular. The heavy, excessive cutting, with its novel prismatic brilliance led the cutters to neglect the form of the vessel itself.

The success of this heavy cutting led finally to the moulding or pressing of glass, thereby achieving rapid and cheap production. Many flint glasses made in England were engraved in Holland, and the Low Countries maintained supremacy in engraving.

At the present time France, Germany, and Sweden are the centres of experimental engraving. Artists are employed in Sweden to design decorations, notably Simon Hald and Edward Gate, at the Orrefors Works. Perhaps the most interesting experiments are in operation in Dresden. Walter Nitschke, and Anton Peter Witt were trained there.

In conclusion, Mr. Butterworth stated that Mr. Percy Metcalf, the designer of the Wood Medal (presented by the Society of Glass Technology to the University of Sheffield) was reported to be experimenting on a new technique in glass engraving.

The lecture was amply illustrated by numerous lantern slides.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

Proceedings at Monthly Council, held at 16, Bedford Square, W.C.1., on April 10, Lord Desborough, K.C. (Vice-President), in the Chair :—

Mr. H. Dent Brocklehurst (Chairman of the Chemical Committee) reported that the list of samples analysed for members during the month of March had been submitted to the Committee.

The following report arising out of certain matters in his correspondence had been presented by the Consulting Chemist :—

Foreign Barley.—Since the last report to the Council (March 6), further information on this subject has been gained, and an enquiry set on foot by the Ministry of Agriculture has resulted in showing that, in certain cases investigated and where injury has been done to pigs, the cause has been traced to a particular fungus. Further cases have been brought to my notice where foreign barley—under the name of "Federal Barley" or "Canadian Feed Barley" has been used, either alone or mixed with home-grown barley for preparing barley meal. Besides barley, a quantity of oats has been present, sometimes with wheat and weed seeds as well. In one of the counties for which I act as agricultural analyst, two such cases of impure barley meal have been referred to the Ministry of Agriculture with the view of instituting proceedings under the Fertilisers and Feeding Stuffs Act.

Algerian Barley. — Yet another and undesirable kind of foreign barley has come to the fore. A member of the Society, resident in Derbyshire, sent me in February, a sample of barley meal for analysis, stating that he had had several of his pigs die. I found the barley, although free from other grain, to be very acid and in unsound condition. Further ,it contained 4.35 per cent. of sand. I subsequently ascertained that the meal had been bought as "barley meal" from a local firm of millers, who stated that they never made this from any but home-grown barley. The firm, on receiving my report, admitted that the meal was made from Algerian barley, and they at once offered to take the meal back and to compensate the owner for his losses.

Screw-Pressed Linseed Cake, Mouldy and containing much Sand.—A member of the

Society, resident in Shropshire, sent me for analysis a sample of screw-pressed linseed cake, stating that, since using it, his cattle had gone off their feed and were scouring badly. A veterinary surgeon's report confirmed this. Samples from three different bags of the one delivery were sent to me, and these I found to vary somewhat, the one from the other. But the delivery contained many lumps which, on breaking, were found to be very mouldy and acid. Further analysis showed the samples to contain sand to the following extent :—

Bag 1, 8.29 per cent.; Bag 2, 6.31 per cent.; Bag 3, 6.59 per cent. The cake cost £13 10s. per ton.

With regard to foreign barley it had been decided to make a recommendation to the Council that representations be made to the Ministry of Agriculture to exact for foreign barley the same standard as is required for English barley.

Mr. Brocklehurst moved the adoption of the report. He wished to refer again to the question of foreign barley, which came up at the last meeting but one of the Council. He would like to state the position briefly, so that any member who was not present at the previous meeting would be in possession of the facts. The barley grown in the United States, if it contained 50 per cent. or more of barley, was passed and counted as barley. The definition allowed the admixture of a large proportion of oats or wheat or other impurities. Because such barley was cheaper it was largely imported into this country, and it was ground alone or mixed with home-grown barley and sold as barley meal. The result was that all over the country there were numerous cases of inferior barley meal. This acted most unfairly upon the grower of barley in this country, who had to comply with the Feeding Stuffs Act, which defined barley meal as the meal obtained by grinding the pure barley as grown. The matter came up on the previous day before the Chemical Committee, and that Committee thought that it was one of importance for the home grower. It recommended that the Council should make a representation to the Ministry of Agriculture, exacting the same conditions for foreign barley as for home-grown barley. The moment was opportune for making such a representation, because reports of the cases were now before the Ministry with a view to action being taken, and to the institution of proceedings in reference to inferior barley meal.

The report was adopted.

NOTICES OF BOOKS.

Průmyslová Vyrobá Plynů (The Industrial Production of Gases). By PROF. J. MILBAUER, D.Sc. Pp. 450. Prague: Ceskoslovenská Spolecnost Chemická (Czechoslovak Chemical Society). Price Kc. 135.

In the Preface to this comprehensive treatise the author refers to the remarkable changes that have taken place in the heavy chemical industries since the last edition of Lunge's Technology appeared. Prof. Milbauer expresses the opinion that at the present time the principal basis of the technology of inorganic chemistry is no longer the soda industry, but is now the production of industrial gases with which the production of acids, salts, fertilisers, etc., is closely allied.

The productiou of all the industrial gases are described in detail together with an account of their occurrence, noteworthy technical properties, their numerous applications and their preparation on the large scale. In this connection the running costs are given and the patent literature has been searched and quoted. Extensive reference is made to the commercial uses of gases, modes of transport, modern practices, protecting and safety arrangements, current prices, by-products, the principal manufacturers, general statistics and other information. Only a brief reference is made to historical and obsolete methods, the author being concerned with current processes and the present state of the industries in Czechoslovakia. Laboratory methods and processes of purely academic interest are likewise scarcely even mentioned, although physical, chemical and mechanical properties are given in full. The text includes nearly 200 excellent schemes and photographs of factories and plant with which the author is personally familiar either from his works experience or in his capacity as Professor at the Technical University of Prague.

The gases treated in the present volume are hydrogen, oxygen, nitrogen, chlorine (electrolysis of alkali chlorides), fluorine, ozone, hydrobromic, hydriodic and hydrofluoric acids, sulphuric acid, oxides of nitrogen, and nitric acid, sulphur dioxide, oxides of carbon, phosgene, methane, acetylene and silicon tetrafluoride. In addition the preparation of gases for airships and the (rare) inert gases are described as are also a number of gases with future possible technical applications. There are, finally, some remarks concerning chemical warfare.

This excellent book written by one of the best-known Czech technologists as Professor J. Milbauer is, can be recommended equally to students of chemical and mechanical engineering as well as to practical (works) chemists and, indeed, deserves to be translated into one of the world languages.

PROF. C. K. KRAUZ.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Monday, May 6, at 8 p.m.—(Cantor Lecture.) Sir E. Denison Ross, C.I.E., Ph.D., Director, School of Oriental Studies : "Nomadic Movements in Asia." (Lecture IV.)

Wednesday, May 8, at 8 p.m.—Ordinary Meeting.

Friday, May 10, at 8 p.m.—Indian Meeting.) Captain P. Johnston-Saint, M.A., F.R.S.E., Secretary, Wellcome Historical Medical Museum : "An Outline of the History of Medicine in India." (Sir George Birdwood Memorial Lecture.)

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

Monday, May 6, at 2.30 p.m.—"The Air Defence Exercises of 1928, with Special Reference to the Air Defence of London." A Public Lecture by Air Vice-Marshall F. R. Scarlett, C.B., D.S.O., Commanding Fighting Area of Air Defence Command.

Monday, May 6, at 6.30 p.m.—"The Literary and Historical Study of the Bible : Daniel." A public Introductory Lecture to a course of University Extension Lectures by the Venble. R. H. Charles, D.D., Archdeacon of Westminster. Chairman : Miss M. S. West, B.D., B.A.

Tuesday, May 7, at 7.30 p.m.—Guild of Graduates' Dinner to new Graduates

Wednesday, May 8, at 2.30 p.m.—Presentation of Degrees at the Albert Hall.

Wednesday, May 7, at 5.30 p.m.—Graduation Service at Westminster Abbey. Preacher : The Right Rev. Bishop Charles Gore, D.D.

Wednesday, May 10, at 8 p.m.—Graduates' Dinner at the Merchant Taylors' Hall.

Friday, May 10, at 5.30 p.m.—"Norwegian Ballads." First of a course of three public Lectures, with Musical Illustrations, by Lektor Rolf Pande. May 10, 15 (Wednesday), and 17.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

11,133.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of aromatic amino sulpho chlorides. April 10.

11,134.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of β-naphthylamino-aryl hydroxy fatty acids. April 10.

11,233.—I. G. Farbenindustrie Akt.-Ges. Manufacture of aldehydes from alcohols. April 11.

10,807.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of hydrogen. April 8.

10,975.—Kelly, A.—Production of acid sodium sulphite. April 9.

Specifications Published.

309,202.—Fairweather, D, A, W., Beckett, E. G., Thomas, J., and Scottish Dyes, Ltd.—Production of calcium or other alkaline earth metal benzoates and benzoic acid.

309,001.—Potts, H. E. (Plauson, H.).—Process for synthesizing nitrogen compounds.

309,002.—Potts, H. E. (Plauson, H.).—Process for the synthesis of liquid hydrocarbons.

309,224.—Crooker, H. L.—Art of chemical heat and storage.

309,258.—Synthetic Ammonia & Nitrates, Ltd., and Rule, A.—Process and apparatus for effecting chemical reactions under pressure.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstracts Published.

305,860.—Hydrocyanic acid.—Johnson, J. Y., 47, Lincoln's Inn Fields, London.—(I. G. Farbenindustrie Akt.-Ges., Frankfort - on - Main, Germany.

Hydrocyanic acid is obtained from alkali metal cyanides or mixtures containing these compounds by decomposition with sodium bicarbonate in excess in presence of water

at temperatures up to 50° C. The hydrocyanic acid may be separated in gaseous form by the use of reduced pressure.

306,421.—*Purifying oils, pitch.*—Hoffman, F., 15, Novastrasse, and Uloth, R., 36, Auenstrasse, both in Breslau, Germany.

Coal tar oils are purified by treatment with sulphur or a substance yielding sulphur, *e.g.*, an alkali polysulphide, at an elevated temperature and preferably increased pressure. 200-300° C. at 5-30 atmospheres for 1-2 hours with 1-3 per cent. of sulphur is suitable. In examples, crude benzene is passed at 300° C. over pumice impregnated with sulphur, and crude benzene vapour is passed through molten sulphur at 200-300° C. The polymerisation products contain the sulphur and are valuable pitches.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

NEO-INFUNDIN.

500,462.—Chemical substances prepared for use in medicine and pharmacy.—The Wellcome Foundation, Ltd., 67, Holborn Viaduct, London, E.C.1. April 3.

SPUMAN.

496,935.—Chemical substances prepared for use in medicine and pharmacy.—August Karreth, trading as Luitpold-Werk Chemisch - Pharmazeu - tische Fabrik, Luitpold-Werke, Zielstattstrause 9, Munchen 25, Bavaria, Germany. April 10th.

ULTRAY.

498,532.—Chemical substances prepared for use in medicine and pharmacy.—The Dubarry Perfumery Co., Ltd., also trading as Dubarry et Cie., Goldstone Laboratories, Hove Park Villas, Hove, Sussex. April 10th.

SOLEIL D'OR.

497,898.—Chemical substances prepared for use in medicine and pharmacy, but not including medicated soap.—Lady Zoe Caillard, The Belfry, West Halkin Street, London, S.W.1. April 17.

" CHEMICAL NEWS "—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, " CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

Anti-Acid Specialities!

"CONTRACITE"
Compressed Cubes.

"KAUTSHIT" Cloth
A Perfect Resistant for acids.

SOLE MAKERS: THE WATPROOF CO.,
18, Rue de Bretagne, ASNIERES (Seine)
FRANCE.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3604.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Water Softening 289
By a Well-Known Engineer.
Synthetic Drugs 290
By Francis H. Carr, C.B.E.
The Reactions of Certain Olefines 292
By William Earl Messer.
Potentiometric Bromination of Beta-Naphthol-Sulphonic Acids 293
The Estimation of Sulphur in Rubber 294
By J. G. Mackay.
Chemical Constituents of Petroleum 294
By E. W. Washburn, J. H. Bruun, and M. M. Hicks.
Experimental Studies on Form and Structure of Sparks 295
By T. Terada, U. Nakaya, and R. Yamamoto.
Identification of Artificial Silks and Textile Fibres 295
The Sulphuric Acid Industry in Japan 296
General Notes 297
Correspondence 299
Proceedings & Notices of Societies:—
The Royal Society 299
The Royal Institution 301
The Optical Society 301
Notices of Books 301
Forthcoming Events 303

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

WATER SOFTENING.

AN INTERESTING PLANT FOR HIGH MAGNESIUM CONTENT WATER.

BY A WELL-KNOWN ENGINEER.

It is familiar knowledge that one of the chief difficulties in water softening according to the lime and soda ash principle is the presence of magnesium, which by the action of sodium carbonate only precipitates slowly as hydrate, quite different from the calcium carbonate, easily separated. For this reason with hard water containing any appreciable amount of magnesium, ample settling time is essential, and the latest methods in this connection are well illustrated by a large "Paterson" softening plant that has been started up at the Annesley Depôt (Nottingham) of the London & North Eastern Railway Company.

This is the vertical cylindrical tank type, with complete steel housing over the top, having a duty of 10,000 gallons of water per hour, the main tank being of very large size, 37ft. 0ins. high, and 10ft. 0ins. diameter.

Also a main feature is the well-known by-pass "Osilameter" feed gear for the reagent, in which the inlet water flows at the top of the plant into a small longitudinal chamber containing a weir, which is divided by a vertical plate or partition movable horizontally to and fro by the simple operation of a wheel valve dividing the flow of the water over the weir into two portions. The larger part of this flow, generally about 80 per cent. of the total, passes out and operates a vertical water wheel which discharges the water into a short horizontal trough passing down into the central reaction and precipitation pipe of the plant.

The smaller portion of the flow from the weir, that is about 20 per cent., passes into a small tipper or "Osilameter," divided into two compartments, so designed that when one of these is filled with water, the Osilameter overbalances by the weight, thus emptying out the water, which then flows to the small mixing horizontal trough and joins the main flow of the water wheel. At the same time this "Osilameter" is provided with small buckets which are always filled with the lime and soda ash reagent, and discharged to the reaction pipe at very short intervals. The design ensures in the first place that the reagent must be added in a definite relation to the total flow of water, no matter how this may vary, since if the volume is increased the amount of water passing over the weir is increased

and the operations are quicker, and vice versa.

If now it is desired to alter the definite percentage of the reagent as required by the varying hardness of the water, this is accomplished by merely turning the hand wheel at the top of the plant, and adjusting the position of the vertical plate or division of the weir, so that a greater or less percentage of the total flow of the water is diverted to the "Osilameter" and operates it quicker or slower in proportion.

BRITISH SCIENCE GUILD.

Developments of British Chemical Manufactures.

SYNTHETIC DRUGS.

By Francis H. Carr, C.B.E.

An Address delivered at a Public Meeting at the Mansion House, London, on April 24, 1929.

Of all the results of modern science perhaps the happiest is the progressive improvement in public health, due to the better understanding of preventive and curative medicine. For this has not merely given relief to physical suffering and lengthened men's lives (the mean expectation of life of a child to-day is ten years more than it was fifty years ago), but it has removed also many of those causes of fear and uncertainty which used to beset life in much greater degree than they do now.

Chemistry is not the lest of the sciences that have contributed to this progress, and medical treatment has become increasingly dependent on the use of substances prepared by chemical synthesis.

Chemical substances are employed in medicine for several different types of effect. First, there are those agents which make good any deficiences due to diet and to other causes, as, for instance, a lack of compounds of iodine, which causes goitre, or of Vitamin D, without which rickets ensues. Second, those hypnotic, analgesic and anæsthetic drugs, of which aspirin and novocaine are very well-known examples. Such drugs relieve pain and secure rest, and thus give freer scope to the power which the body possesses to overcome disease by producing its own curative substances. Of the greatest importance to curative medicine, however, are those substances which, within the human body, exert a direct action upon the disease by destroying the parasitic organisms. Although in this class there may be included the old and well-known drugs, cinchona and ipecacuanha, very few of the old act as these do on the invading organisms of disease.

The discovery in 1894 of diphtheria antitoxin, by which the mortality from diphtheria was reduced to one-tenth of its former figure, afforded perhaps the first real indication of the potentiality of drugs actually to overcome disease, and it gave some reason to hope that in the course of time chemical substances for counteracting all forms of disease would be discovered. Although that consummation is far from being achieved, much progress has been made in known drugs have been found specifically to medicinal chemistry since the discovery of antitoxins and, in a sense, as the outcome of it.

Basing his work on the theory of the action of these antitoxins, Ehrlich was led to discover salvarsan—a synthetic arsenic compound used for its specific effect on the organisms of syphilis. Thus, a new epoch in synthetic drugs may be said to have commenced with the introduction of salvarsan. Through its use, and that of its derivatives, it is now possible to cure, with little risk of recurrence, most, if not all, cases of syphilis. This is one of the worst infectious diseases; its ill effects cause the most widespread human misery.

The great success of salvarsan was a strong incentive to look for other synthetic drugs which exert an antagonistic effect on disease organisms without damaging the infected person. In this, considerable success has already been achieved.

The use of dyes which appear to exert their action by selectively attaching themselves to the invading organism has been one important outcome, and to-day acriflavine and trypan blue are well-known examples of dyes very successfully used in medicine. Various new organic compounds of arsenic and antimony have come into use, especially in the treatment of tropical diseases caused by amœba-like organisms.

Many other examples might be mentioned, but it is necessary to add that in regard to only a few of them has the very high percentage of cures observed in the case of the syphilitic remedies been realised, and the problem is proving more difficult than might have been expected from the great success of salvarsan. Progress depends partially on experimental work carried out on animals infected with diseases, but many diseases cannot be transmitted to animals. Consequently, much research needs to be undertaken and many difficulties overcome, but that the ultimate issue will be the discovery

of many valuable remedies there can remain no possible ground for uncertainty.

For instance, we may look forward to such achievements as the discovery of a compound which will eradicate the germ of tubercle from the body, but a prolonged research must be expected before we can find a compound which leaves the body unchanged and yet directly or indirectly destroys specifically the infecting bacteria of tuberculosis, the action being continued long enough to destroy the bacteria in their resistant stages.

Caprokol, a new internal antiseptic employed with much success for infections of the kidney and bladder, was discovered by preparing and testing a number of resorcinal derivatives, each differing from the other by an additional carbon atom in the molecule. By testing the bactericidal value, first of all outside the living body and later within it, it was determined which member of a series of resorcinol derivatives destroyed the most bacteria. The hexyl resorcinol (or "Caprokol," as the discoverer has named it) was found to be by far the best, and a more powerful urinary antiseptic than any other hitherto discovered.

The search for new synthetic drugs has shown with added force the necessity for understanding the chemical processes which go on within the body, and progress is being profoundly influenced by the increasing knowledge of bio-chemistry.

In its normal chemistry the body is continually producing active principles, for the most part secreted by special glands. These principles are chemical substances which control and regulate the body's action, and thus make adjustments to the continual changes of environment to which the body is subject. study of them has already given us some knowledge of the particular chemical configurations and physical properties which are associated with specific effects, and so is helping the chemist in the search for new medicaments. But, in addition, it hos made it possible to replace the natural supply of these principles when, through some defect, the body is unable to produce them in sufficient amount for normal good health. Of these substances insulin, although not yet made synthetically, affords an outstanding example, because its manufacture has done much to relieve suffering and to prolong life. The main part played by insulin, both in the healthy and in the diabetic man, is to promote the storage of carbohydrate. Sugar is converted into glycogen and stored as such; from this source the blood continually derives material to maintain a normal level of sugar concentration, above or below which health suffers. A healthy body produces insulin in the pancreas, and continually discharges it into the blood stream, so as to maintain the blood sugar at the usual level. By a wonderful adjustment the supply of insulin is increased when the blood sugar rises, and is cut off when it falls below the normal. The person with diabetes is one in whom the supply of insulin is defective; he becomes ill and finally dies. Today such a person may be maintained in health by making up the deficit with external supplies of insulin which the manufacturing chemist prepares from animal pancreas. The actual weight of insulin required by a diabetic patient is minute, because its activity is so high; one part accounts for the removal from the blood of forty thousand parts of sugar, so that, despite its importance, a few hundred pounds weight of pure insulin represent the world's annual requirement. Its value is to be estimated in terms of the vigorous health it gives to the hundreds of thousands of men and women who would otherwise be borne down by illness. Although insulin can now be prepared in pure crystalline form, very little is known of its exact chemical nature, and this must first be elucidated before one can speak with any certainty of the possibility of preparing it synthetically.

The chemistry of other similar active substances produced in the body has, however, been fully worked out and it is possible to prepare identical substances by chemical synthesis. Thyroxine and adrenalin are good examples of this. While insulin brings about the storage of sugar, thyroxine causes rapid disappearance of stored sugar, by increasing the rate at which the chemical changes involving its destruction occur. So little as 5-10 mgm. of thyroxine will increase this by as much as 45 per cent. Its chemical constitution was recently discovered by Dr. C. R. Harington, a young British chemist who worked out a method for its synthesis and gave this knowledge freely to the world. Its manufacture has been set up by British firms. It involves fifteen separate stages, and is perhaps the most complex synthesis ever applied commercially.

Adrenalin is secreted by the suprarenal gland, situated near the kidneys. Minute amounts of adrenalin exert a powerful physiological effect, which was thus described by Dr. H. H. Dale:

"It may be said to produce all the vascular and visceral reactions which accom-

pany the emotions of anger, excitement and fright. The hair stands on end, the face becomes pale, the heart thumps urgently on the chest wall, the arterial blood pressure rises rapidly, the muscular coats of the bronchioles relax and leave the air-way clear fod vigorous breathing, and glucose, the fuel of themuscular machine, is poured from the carbo-hydrate depot of the liver into the blood stream."

From a knowledge of the chemical constitution of adrenalin, it has not only been possible to make synthetically precisely the same substance, but, further, to produce nearly-related chemical substances which have other valuable medicinal properties.

Closely allied to it is ephedrine — an alkaloid which occurs naturally in the Chinese plant Ma-huang, from which it is commercially produced. This substance, ephedrine, has a valuable use, because its administration powerfully relieves the distressing effects of asthma. This discovery has during the past two or three years proved a godsend in bringing relief to a vast number of individuals suffering from asthma and hay fever. The knowledge previously gained in regard to adrenalin has made it a comparatively easy task now to monufacture ephedrine synthetically, although the product so obtained has a weaker action than the natural alkaloid.

(*To be continued.*)

THE REACTIONS OF CERTAIN OLEFINES OF HIGH MOLECULAR WEIGHT WITH SULPHURIC ACID, HYDROCHLORIC ACID, AND THE AIR.

By William Earl Messer.

(*Thesis presented for the degree of Doctor of Philosophy.*)

It is known that olefines of high molecular weight are present in the fractions from petroleum which are used as lubricating oils. Since sulphuric acid is used in the refining of these fractions, and the behaviour of hydrocarbons of this type with this acid is not understood, an investigation was undertaken to obtain the needed information. The reactions were studied of synthesised compounds which are examples of three important types of olefines. The work included a study of the behaviour of the hydrocarbons with sulphuric acid, hydrochloric acid and oxygen and the isolation of the compounds formed.

Preparation of the Olefines.

Cetene, or hexadecene (1), was prepared by distilling spermaceti under a vacuum of 300-400 mm. The product after purification boiled at 123° at 3 mm., and 163° at 21 mm. Its melting point was 4°, its density was 0.779 at 25°, and the unsaturation was 99+ per cent.

Heptodecene (8) was prepared by distilling a mixture of sodium oleate and sodium ethylate. The crude produnt was refined by fractionation; the oil obtained boiled at 136° at 3.5 mm., and 173° at 16 mm. It froze at about -50°, had a density of 0.795 at 25°, and was found to be 100 per cent. unsaturated.

A mixture of tri-substituted ethylenes was produced by dehydrating a mixture of tertiary alcohols made from ethyl magnesium bromide and the methyl esters prepared from commercial stearic acid. This mixture of olefines was composed of 35 per cent. $C_{22}H_{44}$ and 65 per cent. $C_{20}H_{40}$. Its boiling range was 152°-159° at 2 mm., and 193°-213° at 13 mm. and the unsaturation was 100 per cent.

Mimethyl hepadecyl carbinol was made by the Grignard reaction from methyl magnesium bromide and methyl stearate. This alcohol was dehydrated with anhydrous oxalic acid. The resulting olefine, 2-methyl nonadenene (1), boiled at 146° at 2.2 mm., and 189° at 10 mm.; it melted at 11°-12°, had the density 0.795 at 22°, and the refractive index $n_D^{23.5} = 1.4504$.

Action of the Hydrochloric Acid on the Olefine and on Dimethyl Heptadecyl Carbinol.

Cetene and heptadecene (8) did not react appreciably when shaken with concentrated hydrochloric acid. The chloride which would be formed by the addition of hydrochloric acid to 2-methyl nonadecene (1) was produced by shaking concentrated hydrochlorin acid with dimethyl heptadecyl carbinol for about eight hours. The product obtained was shown to be a mixture which contained 95 per cent. of the tertiary chloride and 5 per cent. of the olefine. After several recrystallisations 2-chloro-2-methyl nonadecene which melted at 19.6°-20° was obtained. When a sample of the chloride, which was 95 per cent. pure, was hydrolysed with alcoholic alkali the product consisted of 65 per cent. olefine and 35 per nent. tertiary alcohol.

Action of Sulphuric Acid on the Olefines.

The olefines were shaken with sulphuric acid of various strengths and after standing some time the resulting acid and olefine layers were analysed. In every case little or no organic material was found in the

lower acid layer. A method for analysing the top layer was developed and tested in a variety of ways. The volumes of olefine and acid before and after shaking were noted as well as time of shaking and the time of standing after shaking. Samples of about .5 g. of the top layer were weighed out. One sample was titrated with iodine solution to determine sulphur dioxide; another was titrated by the Francis method and the result corrected for sulphur dioxide was expressed as the unsaturation. Still another sample was completely hydrolysed by boiling with water and then titrated with alkali to determine the total sulphuric acid present. The free sulphuric acid was determined by titration after it had been separated from a sample of the oil by means of chloroform, which dissolved the organin material.

The straight-chain olefines were attacked by 80 per cent. sulphuric acid and the branched-chain olefines by as low as 70 per cent. sulphuric acid. Acids of 85 and 90 per cent. had about the same effect; after shaking one hour and allowing to stand one or more hours the product contained from 35 to 50 per cent. of sulphuric acid. Concentrated sulphuric acid (95 per cent.) gave a considerable amount of sulphuric dioxide with the straight-chain olefines but not as much with the branched-chain olefines. Increase in time of shaking and standing also increased the sulphur dioxide. Increase of the volume of acid to olefine increased the alkyl sulphuric acid but did not increase the sulphur dioxide. Temperatures much above room temperature increased the sulphur dioxide and tar formation. Fuming sulphuric acid and 100 per cent. sulphuric acid both produced large amounts of sulphur dioxide and carbonised tar even at −15°. The branched-chain olefines formed very little alkyl sulphuric acids in comparison with the straight-chain olefines.

The alkyl sulphuric acids from cetene and heptadecene (8) were isolated in the form of their barium salts, which were analysed. The free alkyl sulphuric acids were isolated by treatment of these salts with an ethereal solution of sulphuric acid, filtering off the barium sulphate and evaporating the ether under a vacuum. The free alkyl sulphuric acids prepared in this way were hydrolysed readily, even by the moisture of the air. When they were present, in the mixture that resulted from the action of sulphuric acid on the olefines, it was necessary to heat them with water containing a small amount of acid to bring about complete hydrolysis in a reasonable time. The alcohols resulting from the hydrolysis of the pure alkyl sulphuric acids were isolated. That from cetene (mostly hexadecanol (2)) melted at 41.5°. The mixture, heptadecano (8) and heptadecano (9), resulting from the hydrolysis of the alkyl sulphuric acids from heptadecene (8) melted at 34°. The solid alcohol formed by the reaction of 2-methyl nonadecene (1) with 85-95.5 per cent. sulphuric acid was isolated and melted at about 45°.

ACTION OF THE OXYGEN OF THE AIR ON THE OLEFINE.

The most easily oxidised olefine of those studied was 2-methyl nonadecene (1). At room temperature and with a layer of the olefine one centimetre thick exposed to an excess of air, 0.23 atoms of oxygen were absorbed after 1,450 hours. The absorption was apparently a linear function of the time.

At 100 and 156° all the olefines were oxidised; the hydrocarbon chain was broken and acids were formed. The unsaturation did not fall below 10 per cent. in any case. The products from the high temperature oxidations were viscous tars having a disagreeable, rancid odour. The boiling range, alcoholic titration, and the determination of carbon and hydrogen by combustion all pointed to the formation of acids as the result of the breaking of the chain of the double bond.

—*Massachusetts Institute of Technology.*

POTENTIOMETRIC BROMINATION OF BETA-NAPHTHOL-SULPHONIC ACIDS.

At the 1929 Annual Meeting of the Edinburgh section of the Institute of Chemistry, Mr. S. D. Forrester read a paper on the above subject.

In connection with an investigation of certain of the beta-naphthol-sulphonic acids, a method of analysis of these separately and in presence of one another was necessary. The most suitable methods appeared to be titration with (*a*) bromine and (*b*) a diazo solution. The first was regarded as the more convenient. The method used was that of Vaubel (adding a standard bromate-bromide solution to an acid solution of the substance to be brominated). Owing to difficulties encountered when using starch-iodide paper as external indicator, it was decided to try the potentiometric method, using a platinum gauze as indicator electrode.

The following four acids have been investigated :—Crocein (2 : 8 naphthalmonosulphonic acid); G (2 : 6 : 8 naphtholdisulphonic acid); Schäffer (2 : 6 naphtholmonosulphonic acid); R (2 : 3 : 6 naphtholdisulphonic acid). After many titrations, using

hydrochloric acid to liberate the bromine, it has been found that Schäffer and R acids, separately or together, can be titrated at room temperature, that G acid can be estimated if a temperature of 50° is used, but that *neither Schäffer nor R acid can be estimated* in the presence of G acid, although the "total" can be found if a temperature of 50° is maintained. If, however, such a mixture is titrated with bromate-bromide solution and sulphuric acid is used to liberate the bromine, then the Schäffer or R acid content can be accurately estimated, provided the concentration of sulphuric acid in the solution is about 10N (20 c.c. concentrated acid added to 50 c.c. of solution). It has been definitely established that, of the beta-naphthol-sulphonic acids investigated, those having a sulphonic acid group in the 8 position (Crocein and G) do not brominate in sulphuric acid solution even at 50°. Further work on these lines is proceeding.

THE ESTIMATION OF SULPHUR IN RUBBER.

By J. G. MACKAY.

Mr. Mackay then read a paper on the above subject.

An account was given of an attempt to devise a method of estimating total sulphur in samples of vulcanised rubber, of greater rapidity than, but still comparable in accuracy with, the customary Carius method. It was necessary in the first instance to prepare a series of vulcanised rubber standards containing varying proportions of sulphur and involving the commoner compounding ingredients. These standard mixings were then analaysed for total sulphur by the Carius method. The analytical figures obtained in this way were lower than the "theoretical" values by more than the allowable amount in mixings containing carbon black, China clay, silica, French chalk and antimony sulphide, and also when compounds of iron and calcium were the "fillers" used. Suggested explanations of these discrepancies were given. The method of oxidation recently described by E. Kahane, involving the use of fuming nitric and perchloric acids, was found to be inaccurate, but, when several modifications were introduced, satisfactory results were obtained. It was shown that the sulphuric acid produced by this method of oxidation could be accurately estimated volumetrically as benzidine sulphate. A procedure for the estimation of total sulphur in rubber was thus developed, and when applied to the standardised mixings was found to give results in as good agreement as those obtained by the Carius method.

APPARATUS AND METHODS FOR THE SEPARATION, IDENTIFICATION, AND DETERMINATION OF THE CHEMICAL CONSTITUENTS OF PETROLEUM.

By EDWARD W. WASHBURN, JOHANNES H. BRUUN, AND MILDRED M. HICKS.

(*Abstract from the Bureau of Standards Research Journal.*)

This paper contains a description of the following apparatus and methods :

1. A rectifying still with a 20-plate column and with means for independently controlling and measuring the temperatures of the plates. The still is designed for distillation in a stream of an inert gas (CO_2) with or without boiling.
2. All-glass rectifying stills for vacuum distillation. They are heated by immersion in an electrically heated bath of nickel shot.
3. Various types of molecular stills by means of which distillation can be carried out at any temperature at which the vapour pressure at the distilling surface is not lower than the degree of vacuum attainable.
4. Methods and apparatus for fractionation by crystallisation or melting.
5. An apparatus for combustion analysis, with special provisions for purifying the oxygen employed and with all rubber connections eliminated. With the aid of this apparatus the formula for any hydrocarbon up to C_{100} can be determined.

The change in the iodine number of a petroleum oil produced by heating it for different periods and at different temperatures up to 370° C. in (*a*) air and (*b*) H_2, N_2, and CO_2, respectively, has been determined, and it is shown that in the absence of air this change is greatly reduced.

Evidence is presented showing that the hazards from exposed mercury surfaces in a laboratory are eliminated as soon as the mercury surface becomes contaminated with a continuous layer of a heavy oil or grease.

EXPERIMENTAL STUDIES ON FORM AND STRUCTURE OF SPARKS.

By TORAHIKO TERADA, UKITRO NAKAYA AND RYAZO YAMAMOTO.

(*Institute of Physical and Chemical Research, Japan.*)

(1) In SO_2 at the normal pressure the sparking potential ($l=3.0$) is about three times that in air. Reduction of sulphur is conspicuous. The photograms of sparks re-

semble to those of wires exploded by heavy current.

(2) Long spark in C_2H_2 is of fibrous structure with typical rectangular bending. It is *surrounded with aureole consisting* of an after glow lasting for 10^{-4} sec.; the glowing matter is imparted with a velocity in the direction of the spark. Carbon particles are reduced.

(3) Long spark in CO_2 is also accompanied with an aureole with afterglow.

(4) Long spark in O_2 is generally of the *three-part type, even when there is no unsymmetry* in the potentials of electrodes. The positive part increases with the decrease of the pressure. The characteristic sinuosity decreases with the pressure. The effects of attaching a needle point leakage to either electrode upon the lengths of the three parts are remarkable and give some insight into *the mechanism of the three-part spark*.

(5) With the decreasing pressure, the long spark in air gradually pass from the zigzag type to the smooth curvilinear type without showing the typical three-part form.

(6) Long spark in SO_2 at reduced pressure approaches in its form to the zigzag spark in air at normal pressure.

(7) *With a water resistance in the circuit*, the long spark in air shows the three-part character and accompanied with an aureole of afterglow. Studies of sparks in N_2, O_2 and a mixture of these gases give some hint on the characteristic behaviour of each gas, though the effect of each constituent in the mixture is by no means additive.

(8) *Long sparks in the organic gases*, C_2H_2, CO_2 and coal gas, obtained with the high resistance circuit, show a common feature, being of wavy form and fibrous chararacter. It seems that the sparks are preceded by a fine core or pilot spark due to the small electrode capacity and then followed by the slow discharge of the main capacity in the form of wavy bright spark. The duration of the photographic luminosity is of the order 10^{-4} sec. in the case of CO_2.

(9) By inserting a slate pencil resistance into the circuit a great variety in form and structure of long spark is obtained, including the flame-like spark as well as the bundle-of-threads form. The variation depends on the variety in property of the slate pencil which is again influenced by the effect of discharge. By the slate pencil the discharge may be made intermittent. "Wellenförmige Entladung" may also be obtained under favourable conditions. A flash-over along the surface of the slate pencil may cause a sudden change in the type of discharge. When a large capacity is discharged in O_2 or air by flashing over a slate pencil resistance, a thick spark with hypical sinuosity may be obtained, being *preceded by a fine pilot spark due to the* electrode capacity. The time interval between the pilot and thick main sparks is of the order of $10^{-?}$ sec.

(10) From all what we have observed in different experiments described in the present part, we may remark the following:

(*a*) Long spark is generally *a phenomenon with definite steps of formation*, requirng a definite time for its completion.

(*b*) The formation of the three-part type spark is prepared by gradual building up of the positive part which depends on the nature of gas, the pressure, the resistance of the circuit, etc. The negative part seems to be governed by the positive part. The middle part only consists of a truly disruptive discharge.

(*c*) When a high resistance is inserted in the discharge circuit a fine spark due to the electrode capacity is first excited which prepares the track for the subsequent discharge of the main capacity. The latter discharge takes place in various forms according to the nature of the gas as well as of the resistance; *viz.*, as an arc-like aureole, as an intermittent discharge with gradually varying periods, or as a disruptive thick spark as in the case of flash-over.

(*d*) The analogy of an electrically exploded wire is not superficial, but lies deeper in the essential mechanism of the phenomena of long spark, especially in the case with the high resistance circuit. The track formed by the initial thin spark is a virtual *wire of conducting gas* which maintains its conducting state for a short time and is exploded by the subsequent heavy discharge.

(*e*) Detailed spectroscopic studies of different kinds of light emitted by different parts of long sparks of different forms are highly desirable and seem worth while also from the purely spectroscopic side of the matter.

IDENTIFICATION OF ARTIFICIAL SILKS AND TEXTILE FIBRES.

Dealing with the identification of artificial silks, a writer in a recent issue of the *Artificial Silk World*, says that " a considerable amount of difficulty is met with in the identification of artificial silks, and more especially regenerated cellulose silks since the reactions of these fibres their diameters and ordinary microscopic features present such slight differences as to make complete

identification impossible. In the case of market in competition with artificial silk in the 'combed fibre' industry, there is also a considerable amount of difficulty in determining their origin.

"A method of examination has been recently suggested which may be used as an aid to the identification of such fibres, and one which also gives some information as to the internal structure and physical state of the fibre. If a ray of light is passed through a transparent medium, such as an artificial silk fibre, a certain amount of the light will be absorbed in its passage and will be unable to pass through the material. In an ordinary composite ray of light this loss will not be noticeable, but if we so arrange the ray of light that it consists of rays vibrating in one plane only the inability to pass through the fibre or portions of the fibre will be quite easily noticed, and, since the passage of the ray is largely dependent on the stresses present in the fibre, a considerable amount of useful information may be gained in this way.

"A modern development of the artificial silk industry is in the direction of combed fibres, short lengths of artificial fibres being carded and combed alone or along with wool, to produce new types of yarns, and this use of artificial silk has given impetus to the use of certain naturally occurring vegetable fibres, such as ramie, nettle, sometimes jute, and some of the aloe fibres. These can be readily detected by polarised light, since they give fairly distinct and characteristic colours, although these may be modified by preparatory treatments. A sample of degummed and caustic soda mercerised ramie gave, when mounted in glycerine, a deep reddish-violet fibre with long orange streaks down the side. At certain sharply defined points, apparently corresponding with the cross lines of the fibre, the colour changed to bright yellow-green, and on turning the Nicol a bright bluish-green appeared. Mounted in water the fibres gave dark violet-red and orange as before, but down the centre there appeared a bright blue line, which started at each 'node' and faded away half-way towards the next 'node.' A sample of New Zealand flax (Phormium tenax) showed bright green, red, and yellow spiral lines, which all turned to bright violet when the Nicol was rotated. Wool in these samples was pale yellow-green with brown patches at the base of the scales. Boiled-off silk showed very little colour effect, spiral lines of pale greenish-yellow only, being noticeable. Cotton showed a clear bluish-grey fibre, with small areas of blue and red at th echange of direction of the convolutions and the same sample mercerised showed no colour effects whatever."

THE SULPHURIC ACID INDUSTRY IN JAPAN.

The sulphuric acid industry is one of the oldest in Japan, and is well established, the investment for its manufacturing plants being estimated at about 60,000,000 yen. Prof. Dr. Mototaro Matsui, the well-known authority in this field, has recently published his opinions on the present state of the industry in the publication of the Tokyo Imperial Industrial Laboratory.

According to his estimation, the present state of the industry is as follows :

	1916.	1920.	1925.	1927.
No. of factories	27	?	49	58
No. of apparatus—Chamber process	70	111	112	117
Contact process	2		15	10
Capacity of production (1,000 tons)	550	800	1,100	1,480
Consumption	?	600	850	1,160
Use—For superphosphate	?	50	53	50
,, Ammonium sulphate		20	18	24
,, Other purposes	?	30	29	26

The unit of the plant of the chamber process was at the earlier period 13-15 tons per day of 50° acid, but it has been increased year after year, and at present the 100 ton unit is actually used. The chamber now used is for the most part cylindrical or hollow cylindrical, with the height of 10-18 m. The tower system is also used, and in some plants the chamber and tower are used in combination.

Prof. Matsui made extensive studies on the loss of nitric acid in the cycle of working, and reached the conclusion that the loss is mainly caused by the incomplete absorption of the nitrogen oxide gases in the Gay-Lussac tower. He also studied the reac-

tions occurring in the chamber by determining the temperature in the chamber, concentration and nitric acid content of the condensed acid, and found a means for the proper control of working. He proposed many important improvements in the designs and working methods, and his proposal of feeding the mist of sulphuric acid into the chamber is giving a good result. The yield of sulphuric acid of 50° Bé per 1 cu. m. of the chamber volume is about 9.kg., and the consumption of nitric acid is about 0.5 per cent. on the weight of the sulphuric acid produced.

The tower system is not yet well established, because of being lacking in experience. The contact process is working well, but a further study is necessary in order to simplify the purification of gas and to save the catalyst.

The pyrites now chiefly used is powdered ore, and is roasted in furnaces such as Herreshoff's. Au excessive dust is produced by roasting, as the ores are blown by the ascending gas current, while they are travelling from flat to flat, and in order to eliminate it, the dust chamber or Cottrell apparatus is used. In the chamber process, however, the gas entering the Glover tower is preferable to be of a high temperature, and therefore the dust chamber should be as small as possible.

GENERAL NOTES.

MINES INSPECTOR, MIDLAND AND SOUTHERN DIVISION.

The Secretary for Mines announces that, consequent on the retirement of Mr. H. A. Abbott, H.M. Divisional Inspector of Mines, from the Public Service on 30 April, he has appointed Mr. W. E. T. Hartley to be Divisional Inspector of Mines for the Midland and Southern Division.

The office of the Divisional Inspector will continue to be located at 13, Bennett's Hill, Birmingham (Telephone No. Central 1246; Telegraphic address—Mines Inspector, Birmingham).

WESTERN AUSTRALIAN FOOD AND DRUG REGULATIONS.

The Board of Trade have received copy of the Food and Drug Regulations, 1929, for Western Australia, which have been issued by the Department of Public Health.

The Regulations, which came into operation on 1 February, 1929, prohibit the sale of any food, drug or disinfectant which is not in conformity with the said Regulations.

Standards are prescribed for various foods and drugs, and among other matters dealt with in the Regulations are labelling, packages, preservatives and flavourings, statement of weight or measure, and poisonous metals in foods.

The Regulations may be seen by persons interested on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

SULPHURIC ACID FACTORY AT CORUNA.

The British Commercial Secretary at Madrid informs us that a scheme is on foot for the establishment of a factory in the vicinity of Coruna for the manufacture of sulphuric acid (utilising iron pyrites from Huelva) and of superphosphates (the raw material to be imported from Casablanca).

The new works will form a branch of the well-known firm of Cros. Sociedad Anonima, of Barcelona, manufacturers of chemical fertilisers and chemicals in general. The head office of the firm is at Princesa 21, Barcelona.

Up to the present the only information as to the course of development is that the necessary land has been purchased; details of the plant to be installed are not available.

BISMUTH AND CADMIUM IN BRITISH COLUMBIA.

A bismuth separation plant was brought into production last December at the Trail smelter of the Consolidated Mining and Smelting Company, following upon the establishment earlier in the year of a plant capable of producing three-quarters of a ton of cadmium daily. The cadmium plant produced last year a total of 246 tons of bars and high-grade cadmium, an amount comparing with an entire world's production of cadmium of less than 1,000 tons per year.

LIQUID TAR FOR ROAD REPAIRS.

Contracts for the supply of liquid tar for road repairs have been concluded by the South Metropolitan Gas Company with nearly fifty local authorities in Southern England. These supplies are now being delivered to five county councils, eleven borough councils, twelve urban district councils, and nineteen rural district councils.

" Those Londoners who use gas in preference to coal," said the official who supplied these figures, " are doubly benefac-

tors. Tar, which is one of the chief by-products in the manufacture of gas, is also largely responsible for the smoke emitted from coal fires. Our customers, therefore, while keeping the atmosphere in which they live free from smoke pollution, are also assisting in the repair of the principal motoring roads extending from London to the South Coast."

LARGE-SCALE MANUFACTURE OF FERTILISERS.

The Consolidated Mining and Smelting Company of Canada, Ltd., in its annual report just issued, intimates that experiments made last year on prairie farms in the use of triple superphosphate from the Trail smelter proved satisfactory. With the completion of the first unit of the contact sulphuric acid plant, production on a commercial scale of acid phosphate will be begun. Consideration has been given to the production of sulphate of ammonia. It is likely therefore that in the near future the Company will be a larger producer of synthetic fertilisers.

CRUDE OIL FROM ALBERTA BITUMINOUS SANDS.

The Bituminous Sand Extraction Company of Calgary are planning to extract crude oil from the bituminous sands of the McMurray district of Northern Alberta and for this reason are obtainiug a high pressure boiler and new drilling equipment. According to Mr. Curt Smith, of Wetaskiwin, it is intended to prove definitely the commercial value of the Absher extraction process for which the Company holds the rights, and which has already been successful in small experiments.

The bituminous sand deposits of Northern Alberta are of enormous magnitude and offer unlimited quantities of raw material. In fact the petroleum content, if it can be commercially extracted, would supply the world for many years.

SULPHURIC ACID PLANT TO BE ERECTED AT COPPER CLIFF, ONTARIO.

According to a recent announcement, Canadian Industries, Limited, will erect, in the near future, a sulphuric plant at Copper Cliff, Ontario, at an estimated cost of $1,500,000, which will manufacture sulphuric acid on a fairly large scale.

$4,000,000 COPPER REFINERY TO BE ERECTED AT SUDBURY, ONTARIO.

According to an announcement by the Prime Minister of Ontario in the Provincial Legislature, arrangements have been completed for the erection of a copper refinery at Copper Cliff, in the Sudbury district of Ontario, by interests including the International Nickel Company; Consolidated Mining and Smelting Company of Canada, Ltd.; Sherritt Gordon Mines, and Ventures, Ltd. The plant, which will cost at least $4,000,000, will have an initial capacity of 120,000 tons per annum, will require the employment of 600 men with a pay-roll of approximately $730,000; and have an annual expenditure for supplies and materials estimated at $300,000. The hydro-electric power requirements will be about 6,000 horse-power. Building of the new refinery will commence immediately and it will be completed and ready for operation in about 18 months.

NEW SULPHUR EXTRACTION PROCESS.

Professor M. C. Boswell, of the Faculty of Applied Science in the University of Toronto, is stated to have developed an important new process for the extraction of sulphur from the sulphur dioxide gas produced in Canadian metallurgical plants. At present three million dollars worth of sulphur is brought annually into Canada, the greater portion of which is used by the pulp and paper industry. Should Professor Boswell's discovery lead to the economical production of sulphur in Canada, the benefit not only to the mining industry but also to the pulp and paper industry would be very great. It is believed that as much as six or seven per cent. of the fumes from Canadian smelters consists of sulphur dioxide, the effect of which on surrounding vegetation is very serious.

OIL AND GAS DEVELOPMENTS IN WESTERN CANADA.

Progress in the oil and gas fields of Western Canada is very satisfactory, but all the oil and most of the gas production, accordiug to a recent statement made by Dr. G. S. Hume, of the Geological Survey branch of the Department of Mines at Ottawa, is still confined to Alberta. Production of oil in Alberta in 1928 amounted to 410,623 barrels of crude naphtha, 70,734 barrels of light crude, and 8,174 barrels of heavy

crude; 489,531 barrels in all, an increase of 47 per cent. over the total output for 1927. Over 14,000,000 M cubic feet of natural gas was consumed in Alberta in 1928.

CORRESPONDENCE.

THE EDDINGTON INTERSTELLAR CLOUD.

(*To the Editor of the* CHEMICAL NEWS.)

Sir,—According to Prof. Eddington interstellar space instead of being "a region of intense cold, is a hot cloud, kept at a high temperature by the collision of its own particles." Before adopting such a revolutionary conception, let us consider the fact that we should get the same kind of evidence on which Prof. Eddington bases his belief if our solar system were simply surrounded by clouds of calcium and sodium vapours. The spectrum would show a series of black lines representing the radiations that have been intercepted. When we take into consideration the vast clouds of calcium thrown out by the sun we have to ask ourselves what becomes of this calcium. My atomic model—which is modelled on the solar system—apparently indicated that it was repelled as far as the orbit of Neptune while the sodium would be repelled still further—to the orbit of the planet that is supposed to be beyond Neptune. On the other hand to our planet—of which the chief constituent is iron—would be repelled the iron atom-rays and hence we can understand why iron holds such a predominating position in our spectral lines. As these clouds of vapour would be constantly receiving fresh atom-rays they may well appear to be in an ionised condition. This, surely, is more credible than the supposition that these particles are kept at a high temperature by their own collisions although they are so rarefied that they are even as a puff of smoke would be if it were "expanded to fill a cube ten miles in length, breadth and height."

Anyone interested in this view of the matter may refer to my book, REFLECTIONS ON THE STRUCTURE OF THE ATOM (1926) or to my articles in back numbers of the *Chemical News*.

FLORENCE LANGWORTHY.

MOTOR-CYCLES IN NEW ZEALAND.

The Officer-in-Charge of H.M. Trade Commissioner's Office at Wellington reports that 40,080 motor-cycles were registered in New Zealand as at 31 January, 1929.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Papers read on Thursday, May 2:—

The Loss of Water and Salts through the Skin, and the Corresponding Physiological Adjustments. By J. S. HALDANE, F.R.S., W. HANCOCK AND A. G. R. WHITEHOUSE.

The paper, which is a continuation of the work of Prof. K. N. Moss, a former Tyndall Student (*Roy. Soc. Proc.*, B., vol. 95, p. 181, 1923), contains data as to the nature and percentage amount of salts lost from the skin without sweating and in different stages of free sweating. To this account is added a discussion, with experiments, as to how far the sweat-glands take part in regulating the composition of the blood, and as to the actual nature of the disturbance produced when loss of salts and water is replaced by gain of pure water. The manner is described in which this disturbance is ordinarily prevented by the compensatory action of the kidneys and a natural craving for salt. The conclusion is drawn that what is kept practically constant is the diffusion pressure of water within the body, in accordance with Claude Bernard's conception of the blood as an internal environment maintained constant by the co-ordinated action of organs. When, under exceptional conditions, the diffusion pressure of water rises considerably, as in cases of miners' cramp, or to a still more serious extent in cholera, the physiological effects produced are very violent.

Oestrus and Pseudo-Pregnancy in the Ferret. By DR. F. H. A. MARSHALL, F.R.S., AND J. HAMMOND.

"Heat" is prolonged in absence of coitus. The vulva enlarges to about fifty times its anoestrous size and persists to cessation of heat. Ovulation occurs at any time during heat, but only after coitus. The anoestrous uterus is small, thin and anæmic, and the muscosa dense and without folds. It increases in size at oestrus and the lower layer of glands develop as well as the folds. Plasmodial layer reaches maximum about fifth week, and breaks down in about 5½ weeks. Regeneration takes place at the eighth week. Changes in uterine musoca are similar to those during pseudo-pregnancy. Changes of one sterilised uterine horn are similar to those during pseudo-pregnancy. Hypertrophy of mammary glands is similar to that during pseudo-pregnancy. These comparable changes are

apparently controlled by the development and persistence of the corpus luteum. The vulva affords no external indication of the *luteal* phase which is the main factor in the development changes.

The Effect of Gamma Irradiation on Cell Division in Tissue Culture in vitro. By R. G. Canti and F. G. Spear. Communicated by Sir Frederick Andrewes, F.R.S.

1. In cultures irradiated with gamma rays under the conditions of the experiment it was found that the fall in the number of cells undergoing mitosis was followed by a rise.

2. With a certain duration of exposure and with the intensity of irradiation employed in the experiment this return of mitosis was compensatory to the fall.

3. With longer exposures, though there was a tendency to rise, the number of cells undergoing mitosis never reached the normal.

The Absorption Spectrum of Vitamin D. By R. B. Bourdillon, C. Fischmann, R. G. C. Jenkins and T. A. Webster. Communicated by Dr. H. H. Dale, Sec.R.S.

The action of ultraviolet radiation on ergosterol has been studied by comparing the absorption spectra and antirachitic activity of the products formed. It is concluded that three substances (or groups of substances) are produced in succession, of which the first shows an absorption band roughly similar to that of ergosterol (maximum 280$m\mu$), but more than twice as intense. This absorption is accompanied by great antirachitic activity, and evidence is given showing that the substance concerned is probably vitamin D.

The second product, which is formed by further radiation of the first, shows a strong absorption band, with maximum at 240$m\mu$, and has no antirachitic activity. The third substance is formed by further radiation of the second, and shows neither antirachitic activity nor marked absorption.

A method of calculation is described by which the actual percentage of vitamin D present in the purest preparations studied is estimated as over 50. Absorption curves are shown which are believed to be of closely similar shape to those which would be shown by pure preparations of vitamin D and of the second product of ratiation.

The following papers were read in title only :—

Researches on Vegetable Assimilation and Respiration.—XX. By G. E. Briggs. Communicated by E. F. Blackman, F.R.S.

The Relation of the Critical Frequency of Flicker to the Adaptation of the Eye. By R. J. Lythgoe and K. Tansley. Communicated by Sir John Parsons, F.R.S.

As a result of experiments we have drawn the following conclusions : —

(*a*) That the critical frequency due to the cones falls during dark-adaptation and with decreasing levels of light-adaptation and is highest with equally bright surrounds.

(*b*) That the critical frequency due to the rods rises during dark-adaptation and with decreasing levels of light-adaptation and is highest with completely dark surrounds.

(*c*) The peripheral cones are functiopally not identical with the foveal cones.

(*d*) The brightness of the surrounds is the most important factor in determining whether the critical frequency relations are of the rod or cone type, bright surrounds encouraging the cones and dark surrounds the rods.

(*e*) At intermediate illuminations of the test-patch and surrounds the resultant critical frequency appears to be due partly to rods and partly to cones.

(*f*) The results got by the critical frequency of flicker method are in good agreement with the performance of the eye under other visual tests.

(*g*) The Ferry-Porter law was found to hold only at 10° on the peripheral retina when the brightness of the surrounds was the same as that of the test-patch.

Reduced Hæmatin and Hæmochromogen. By R. Hill. Communicated by Sir Frederick Hopkins, F.R.S.

The Development of the Skull of the Shrew.. By G. R. de Beer. Communicated by E. S. Goodrich, F.R.S.

The Influence of Witte's "Peptone," and of Digestion on Blood Platelets and Plasma. By J. W. Pickering. Communicated by W. D. Halliburton, F.R.S.

Compensatory Hypertrophy of the Untreated Ovary after Unilateral X-ray Sterilisation. By F. W. R. Brambell and A. S. Parkes. Communicated by J. P. Hill, F.R.S.

The Differential Action of X-rays in Relation to Biology, Chemistry and Physics.—Part I. By W. Moppett. Communicated by J. T. Wilson, F.R.S.

The Trypanocidal Action of Some Derivatives of Anil and Styryl Quinoline. By C. H. H. Browning, F.R.S., J. B. Cohen, F.R.S., S. Ellingworth and R. Gulbransen.

THE ROYAL INSTITUTION.

ELECTION OF OFFICERS.

The annual meeting of the Royal Institution was held at its House in Albemarle Street, on May 1, when the annual report of the Board of Visitors was received. The ballot for new officers was taken, with the following results :—

President—The Duke of Northumberland.

Treasurer—Sir Robert Robertson.

Secretary—Major Charles E. S. Phillips.

Managers—Lord Blanesburgh, Dr. Ernest Clarke, Sir James Crichton-Browne, Professor F. G. Donnan, Dr. W. H. Eccles, Mr. W. Vaux Graham, Mr. J. S. Highfield, Sir Arthur Keith, Dr. Vincent Warren Low, Mr. C. H. Merz, Mr. Robert Mond, Sir Richard Paget, Mr. C. C. Paterson, Dr. G. C. Simpson, and Mr. W. J. Tennant.

Visitors—Mr. M. A. Adam, Professor E. N. da C. Andrade, Mr. J. H. Batty, Mr. F. H. Berryman, Mr. Montague Ellis, Mr. K. R. Hay, Dr. David Heron, Dr. G. W. C. Kaye, Mr. William Macnab, Mr. Emile S. Mond, Mr. H. M. Ross, Mr. W. S. Rowntree, Mr. Sidney Skinner, Dr. Harold R. D. Spitta, and Dr. A. E. Western.

FELLOWSHIP FOR CHEMICAL RESEARCH.

The Ramsay Memorial Fellowships Trustees will consider at the end of June applications for a British Fellowship for Chemical Research. The value of the Fellowship will be £250 a year, to which may be added a grant for expenses not exceeding £50 a year. Full particulars as to the conditions of the award can be obtained from the secretary of the Ramsay Memorial Fellowships Trust, University College, London (Gower Street, London, W.C.1.).

THE OPTICAL SOCIETY.

The following paper was presented and discussed :—

Contributions to the History of the Spectacle Makers' Company. (Second paper on the Court Collection.) By THOMAS H. COURT AND MORITZ VON ROHR. With Exhibits from Mr. Court's Collection.

NOTICES OF BOOKS.

Can We Trade With Russia? By DR. EDOUARD LUBOFF. Pp. 48. London : Anglo-Russian Press, 23-28 Fleet Street, E.C.4. 1929. Price 1s.

The question of Anglo-Russian trade is very much to the fore at the moment and Dr. Luboff's examination of the question whether trade is possible with the Soviets is therefore opportune. The question is answered in the affirmative, and thoughtful observers cannot fail to agree with him when all the facts are considered.

The present trade depression and industrial stagnation is partly due to the loss of Eastern markets for manufactured goods. Re-opening of trade connections with Russia would afford opportunities of supplying its 150 million inhabitants with British manufactured goods, whilst Russian raw material would be very acceptable to a number of our large industries. Any possible danger of a political menace is far more likely to recoil upon the present Russian administration than upon any Government that happens to be in power in England. Another advantage, of greater interest in scientific circles would be the increased facilities for scientists in both countries to visit and co-operate together in matters of common interest.

Die Künstlichen Harze, von DR. JOHANNES SCHEIBER, a.o. Professor and der Universität Leipzig, UND DR. KURT SANDIG (Band 14 der Sammlung " Chemie in Einzeldarstellunger " herausgegeben von Prof. Dr. Julius Schmidt, Stuttgart). Stuttgart : Wissenschaftliche Verlagsgesellschaft m.b.H. 1929. Preis 28 m.

Die künstlichen Harze haben in den letzten Jahrzehnten eine ständig zunehmende Bedeutung für das Wirtschaftsleben erlangt, wobei nur an die Bedürfnisse der Elektrotechnik, der Industrie der Galanterie—und Luxuswaren, insbesondere auch der Lackindustrie erinnert zu werden braucht. Die Zahl der zur Herstellung geeigneter Produkte vorgeschlagenen Verfahren ist infolge des allgemeinen Interesses weiter Kreise in ständigem Wachstum begriffen, sodass eine systematische Zusammenfassung des mehr und mehr anschwellenden und bislang recht unübersichtlichen Gebietes zweifellos der Beachtung sicher sein kann.

Die verliegende Darstellung erscheint besonders geeignet, den interessierten Kreisen das Wesen der künstlichen Harze näher zu vermitteln, da die Autoren sich nicht etwa nur auf eine einfache Aufzählung der verschiedenen Verfahren bezw, lediglich eine Beschreibung der wichtigsten Produkte beschränkt haben, sondern bemüht gewesen sind, gleichzeitig die für eine Kunstharz Herstellung wichtigsten allgemeinen Gesichtspunkte zu entwickeln. Demgemäss beschränkt sich der erste und allgemeine Teil des Werkes ausschliesslich auf eine eingehende Erörterung der Ursachen, welche überhaupt für den harz-

artigen Zustand in Betracht zu ziehen sind. Damit ist die Grundlage für eine trotz weitgehender Spezialdarstellung zusammenfassende systematische Betrachtung gegeben, wie sie im zweiten Hauptabschnitt des Werkes in den Unterabteilungen über polymerisierende bezw. kondensierende Verharzungsprozesse zur Anwendung gelangt ist. Eine speciellere Beschreibung ist mit Recht nur für die in der Praxis besonders geeigneten Harztypen gegeben. Die Gründlichkeit, mit welcher dabei verfahren ist, ergibt sich aus dem Umstande, dass der betreffen de dritte Hauptabschnitt des Werkes in Bezug auf seinen Umfang überwiegt.

Erwähnt sei schliesslich, dass dem Werk einige wichtige V.D.E.--schriften beigegeben sind.

Elektrizitat und Eiweisse. By Dr. Hans Pfeiffer. Pp. viii + 130. Dresden and Leipzig: Theodor Steinkopff. 1929. Price 10 marks.

Dr. Pfeiffer's Electricity and Albumens constitutes Vol. XXI of Messrs. Steinkopff's Series of Scientific Monographs published under the editorship of Prof. R. E. Liesegang. It is concerned with a restricted phase of the ever extending field of Bio- and Colloid-Chemistry. The author indicates the general colloidal properties of egg albumen and the nature of the electrical phenomena which can be applied in the disperse systems. He has in mind those of his readers who are biologists when he describes the ionic and P.D. factors and iso-electric effects.

There are copious references to original papers and the monograph itself is a noteworthy contribution to the literature of the subject.

Origins in Place Names. MI. The Elements. By "An Ignorant Student." Pp. 12. Privately printed at the Chiswick Press, London. Price 1s.

The Legend of the "Francs-Tireurs" of Dinant. (Reply to the Report of Dr. Meurer, Prof. at Wurzburg University). By Dom Norbert Nieuwland, O.S.B., and Maurice Tschoffen. (Translated by E. Louisa Thompson.) Published by J. Duculot, Gembloux, Belgium. 1929.

Organic Synthesis.

An annual publication of satisfactory methods for the preparation of organic chemicals. Pp. 108. Price 8s. 6d. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd.

The Industrial Development of Searles Lake Brines with Equilibrium Data. By John E. Teeple, Ph.D., Consulting Chemist and Engineer and Associate of the American Potash and Chemical Corporation. American Society Monograph. Pp. 188. Price $3. The Chemical Catalog Company, Inc., 419, Fourth Avenue, at 29th Street, New York, U.S.A. 1929.

This is one of the wellknown monographs of the American Chemical Society which in itself is an evidence of the reliability of its contents. The present volume contains important data belonging to the American Potash and Chemical Corporation, and it is obvious that a company with such widespread ramifications have stored upon their dosiers information which must prove both interesting and useful to chemists. These will be found in the present monograph. The more scientific part of the work contains equilibrium data and diagrams, which cannot fail to prove of value to students and scientific men generally. There are no fewer than 60 of these valuable diagrams, which are worth many times the price charged for the work.

PUBLICATIONS RECEIVED.

U.S. Bureau of Standards.

Tables of Spectral Energy Distribution and Luminosity for use in Computing Light Transmissions and Relative Brightnesses from Spectrophotometric Data. By J. F. Skogland. No. 86.) Price 10 cents.

Stoddard Solvent. C.S.3-28. Price 10s.

Simplified Practice, What it is and What it Offers. (1928 edition.) Price 15 c.

Iron and Steel Roofing. (R78-28.) Price 5c.

Woven Wire Fencing. (R9-28). Price 5 c.

Asbestos Paper and Asbestos Millboard. (R19-28.) Price 5 c.

Hard Fibre Twines. (R92-28.) Price 5 c.

Simplified Practice Recommendation. R47-28.

Cut Tacks and Small Cut Nails. Price. 10 cents.

Simplified Practice in the Marine Field Rules as revised in 1928. Price 10 cents.

Recommended Minimum Requirements for Plumbing. Price 35 cents.

Commomwealth of Australia.

The Health and Nutrition of Animals. Reports by Sir A. Theiler, D.Sc., and J. B .Orr, D.Sc. (No. 10.)

We have received a copy of a new Brochure by Messrs. Braby & Co., of Glasgow in which the types of their Eclipse dovetail steel sheeting are enumerated. This and other sheeting is now in considerable demand for flooring.

We have received from the Department of Mine, Canada, a volume entitled *Investigations of Mineral Resources and the Mining Industry.* 1927. I. Bituminous Sands of Northern Alberta—experimental drilling and paving operations. 1927. By S. C. Ells. Pp. 60.

SHEET METAL WORK.

Messrs. Blagg and Johnson, Ltd., the well-known sheet metal workers of Newark-upon-Trent, have issued a handsome illustrated catalogue, shewing beautiful samples of the various useful specialities manufactured by them. The firm will send a copy to any interested reader of the *Chemical News*.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, May 15, at 8 p.m.—Ordinary Meeting. Robert Burrell : " The Reform of the British Patent System."

Wednesday, June 26, at 4 p.m.—Annual General Meeting.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

A Meeting of the Society will be held in the Lecture Hall at the above address on Wednesday, 15 May, at 7.30 for 8 p.m. The following papers will be read and discussed :

" Some New Foraminifera from the South Atlantic.—No. 1." By Mr. Heron-Allen, F.R.S., F.R.M.S., and Mr. Arthur Earland, F.R.M.S.

" The Form of the Chromatophore of the Bright Green Gonidium Common to many Lichens." By Mr. Robert Paulson, F.L.S., F.R.M.S.

" On Three Cases of Encystment Among Rotifers." By Mr. David Bryce, F.R.S.E., F.R.M.S.

The next Ordinary Meeting of the Society will be held on Wednesday, October 16, 1929, when the Annual Pond Life and General Microscopical Exhibition will be held.

The next meeting of the Biological Section wil lbe held on Wednesday, November 6, 1929.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 19 to September 14, 1929.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

11,682.—British Celanese, Ltd.—Apparatus of carrying out chemical reactions. April 15.

12,086.—Cocksedge, H. E., and Imperial Chemical Industries, Ltd.—Promoting crystal growth. April 18.

11,892.—De Pont de Nemours & Co., E. I. —Manufacture of concentrated nitric acid. April 17.

12,213.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of condensation products from carbamides, etc. April 19.

12,142.—Imperial Chemical Industries, Ltd.—Production of hydrogen. April 19.

Specifications Published.

309,516.—Imray, O. Y. (I. G. Farbenindustrie Akt.-Ges.).—Manufacture of 2-amino-3-carboxylic acid and of intermediate compounds.

309,661.—Harris, G. J., and Imperial Chemical Industries, Ltd.—Joint production of sulphuric acid and cement.

287,072.—Nitrogen Engineering Corporation.—Synthetic production of ammonia.

309,734.—Vetterlein, Dr. R.—Method of carrying out chemical reactions and a furnace suitable for this purpose.

291, 434.—Holzverkohlungs-Industrie Akt.-Ges.—Process for concentrating volatile aliphatic acids.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

307,061.—Chromic acid. — Metals Protection Corporation, Transportation Buildings, Indianapolis, Indiana, U.S.A.

Crude dry chromic acid containing, say, 1.5-0.15 per cent. SO_3 is admixed with an amount of a reactive barium compound such as the hydrate, carbonate, or chromate

chemically equivalent or less than chemically equivalent to the sulphate present, whereby on dissolving the mixture in water a solution free from or containing a predetermined amount of sulphate is obtained, which is suitable for use in making up electrolytic baths for chromium plating. The prior use of nitric acid followed by a saturated solution of chromic acid for removing the sulphate is referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by *permission of the Controller of His Majesty's Stationery Office.*

PYSECT.

500,486.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Stafford Allen & Sons, Limited, 7, Cowper Street, Finsbury, London, E.C.2., and Long Melford, Suffolk. April 24.

BIRCON.

500,918.—Chemical substances prepared for use in medicine and pharmacy. —Lionel Alfred Jackson, trading as The London Rubber Co., 183, Aldersgate Street, London, E.C.1. April 24.

CALNITRO.

498,900.—Chemical substances used for agricultural and horticultural purposes. —I. G. Farbenindustrie Aktiengesellschaft, Mainzer-Landstrasse 28, Frankfort-on-Main, ermany. April 24.

FLYING HORSES.

495,800.—Chemical substances prepared for use in medicine and pharmacy.—Societe des Usines Chimiques Rhone-Poulenc, 21, Rue Jean-Goujon, Paris (8e), France. April 24.

500,228.—A circle enclosing the words CUMTAR and THE WEST CUMBERLAND BY-PRODUCTS COMPANY, LTD. FLIMBY. Coal tar. — The West Cumberland By-Products Co., Ltd., Risehow Chemical Works, Flimby, Cumberland. April 17.

" CHEMICAL NEWS "—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, " CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

URGENTLY WANTED

TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.
also
No. 3400. Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3605.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Physical Constants — Supplementary Notes ... 305
By F. H. Loring.
Low Temperature Carbonisation ... 306
By A Well-known Engineer.
Synthetic Drugs ... 307
By Francis H. Carr, C.B.E. ...
Rayon—Artificial Silk ... 309
By A. B. Shearer.
Annual Meeting of Canadian Institute of Mining and Metallurgy ... 312
General Notes ... 313
Correspondence — A Prepared Milk Patent ... 315
Proceedings & Notices of Societies:—
The Royal Society ... 315
The Physical Society ... 316
Institution of Petroleum Technologists ... 317
Royal Institution ... 317
Society of Public Analysts ... 318
Notices of Books ... 318
Forthcoming Events ... 319
New Patents ... 319
New Trade Marks ... 320

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. *Carriage paid,* Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

PHYSICAL CONSTANTS—SUPPLEMENTARY NOTES.

In my survey of the problem of some of the physical constants (this Journal, present vol., pp. 228, 242, 257) the following equation appeared on page 257:—

$$(e/m) \times 10 = (m_H/m)(F/m_H).$$

This is the equation used by Houston (see this Journal, vol. 136, p. 161). It is obvious that m_H can be reduced to *unity* in both places by using a suitable common multiplier, *i.e.*, a reciprocal number. This being done, F remains unchanged, whilst $1/m$ is then equivalent in the equation to *dividing* F by m, therefore the equation reduces to: $(e/m) \times 10 = F/m$.

Now the electrochemical equivalent of silver is fairly accurately known, so that F can be calculated in a well-known way from the atomic weight of silver, as I have already shown on page 257, when transposing.

Taking e/m as 17620907, as resulting from e being $4.776081016 \times 10^{-10}$, h 6.556×10^{-27}, R_∞ 109737.37, c 29979640853 and π_s 3.13941178346, using Flamm's equation as given on page 242, then m (O=16 basis) considered spectroscopically is—

$$m = F/(e/m) \times 10 = 0.000547554,$$

when using Birge's value for F, but taking it at its minimum, 96484—see page 228.

Using the well-known equation for evaluating R_H

$$R_H = R_\infty/(1 + m/m_H) = 109677.7498,$$

being close to Houston's value obtained spectroscopically, which is 109677.759 ± 0.008 (*loc. cit.*). The other values are:—

$R_\infty = 109737.37$ (as before).
$m = 0.000547554$ (as above).
$m_H = 1.00777 - m$ (P. 228 for value of H.)

This is a satisfactory agreement throughout, and the value of F would make the electrochemical equivalent of silver 0.0011181 when taking its atomic weight as 107.8787—not, of course, impossible values.

In this case e has been evaluated by using π while m (spectroscopic—increased in mass due to the relativity effect) has been evaluated by introducing a correcting feature in connection with π, so that it can be written as π_s, the value being as above.

I have expressed considerable doubt about using the π equation for evaluating e, but it may be of interest to note the results as above.

J. Perles (*Naturwiss.*, 1928, *16*, 1094) gives an equation for evaluating h from π, etc., as follows :—

$$h = [1/(\pi - 1)](m_H/m)(e^2/c).$$

Since h is an optical constant it seems reasonable from the foregoing (see *Chemical News*, 1929, *138*, 228, 242, 257) to use *in* this equation the optical or spectroscopic π, *i.e.*, π_s, which is as given above.

When this is done h is 6.556×10^{-27} when $m_H/m = 1843.59309$ (ratio),

$e = 4.776080$, and

$c = 29979640853$

This would make a combination

H = 1.00776269, when

$m = 0.0005463$.

Taking, however, the highest likely value for the atomic weight of hydrogen, viz., 1.00779, gives, with the above ratio, the highest value for the electron in accordance with Perles' equation, thus—

$1843.59309 \times 0.00054635 + 0.00054635 = 1.0077934$.

Using these values in the equation : $R_H = R_\infty/(1+m/m_H)$, gives 109677.882 for R_H.

The corresponding equation for R_{He} being $R_{He} = R_\infty/(1+m/m_{He})$ when m_{He} is the mass of the helium nucleus (He $- 2m = 4.001067$). $R_{He} = 109722.3910$. He is taken as 4.00216 and the hydrogen nucleus m_H is *of course* H $- m$. R_∞ is as above.

It will be seen that with the *fixed* ratio the above values of m and H yield the same R_H constant in each respective case, and while R_{He} agrees closely with Houston's value 109722.403 (see *Chemical News*, 1928, *136*, 161), the Rydberg value for hydrogen (R_H) is perhaps in slight error.

The practically exact value for my π equation is 4.776081016 which is used in the first calculation above instead of 4.77608.

All this goes to show that the newer type of equations given in this study are as good as any others for obtaining close agreements, but the figures must speak for themselves against more refined experiment of the future.

If spectroscopic π is used (π_s)—to return to an earlier feature where I suggested the mass of the electrons entering into the equation, p. 257—then it seems to me that, *with all constants evaluated which are to be in spectroscopic agreement*, π_s must be used, or a correction applied represented by π/π_s or π^2/π_s^2, especially when *mass* is involved.

When this is done, in the equation for evaluating e from Ag, E, and N (p. 257), it would be—

$$Ag(\pi/\pi_s)c/10NE = 4.776080 \times 10^{-10}$$

when $Ag = 107.88$,

$\pi/\pi_s = 1.00069467$,

$c = 2.9979640 \times 10^{10}$ (as before),

$N = 6.06054 \times 10^{23}$, and

$E = 0.0011181128$ (this is consistent with F being 96484).

Some of these calculations have been carried out further in the decimal region than is necessary, but the finished values can be rounded off as desired. Moreover, the values are often comparative and for that reason it is of interest to note the more or less exact relations between them when extending the study.

I started out advocating 4.779, but as the study expanded I have favoured the value 4.776080, notwithstanding Bäcklin's higher value, already discussed in this survey.

It is important to note that in a new Journal : *Physical Review Supplement*, to appear July 1, connected with the American Physical Society (see *Phys. Rev.*, April, 1929, advers., p. 10), there will appear a paper on the probable values of the general physical constants by R. T. Birge. The paper will discuss important relations between the various constants.

It will be of interest to see how far my values depart from those Birge will give, and then to go to sleep for ,say, ten years and after waking up see what has happened.

I may have a further note to add if anything develops that may be considered useful.

On p. 257 the π values given in the ratios are the *decimal fractions*, obviously.

F. H. L.

LOW TEMPERATURE CARBONISATION.

An Important Installation at the Mines de Lens.

By A Well-Known Engineer.

Obviously one of the main applications of low temperature carbonisation is the utilisation of bituminous dust and smalls at the mines to give large sized pieces of high-grade, free-burning, smokeless fuel, equal or superior in value to graded lump coal. In this connection significant is a " K.S.G." plant of one standard retort, 80 tons of coal per 24 hours throughput, now being installed at the Mines de Lens, in the Pas de Calais area. The development of low temperature carbonisation and the important

possibilities as regards utilisation of the fines have been closely studied in the Lens area, and it was decided that the " K.S.G." process was the best available, confirmed by extensive large scale tests with Lens coals, carried out in 1927 on the well-known " K.S.G." retort at the Karnap Collieries, Essen.

As a result a special Company, " Carbonia," has been formed, with which are associated the Mines de Marles, Mines de Dourges, Mines et Houillieries de Marles, Mines de Sarre et Moselle, and the Mines de Vicoigne, Noeux, et Drocourt. This Company is erecting the " K.S.G." plant, and as usual the standard retort with a throughput varying from 65-85 tons per 24 hours, is a rotary, slightly inclined, steel cylinder, 76 feet long by 10 feet diameter, having an inner cylinder 5 feet 8 inches, while the speed is one revolution in 90 seconds, with $2\frac{1}{2}$ hours heating and a maximum temperature of 925-1025° F. The yield follows the normal low temperature practice, from one ton of average bituminous coal of 25-35 per cent. volatile matter being 3,500-5,000 cubic feet of rich gas at 800 B.Th.U., 3 gallons light oil scrubbed from the gas, 15-20 gallons low temperature tar, and 14cwt. smokeless fuel with 10-12 per cent. volatile matter.

The site is at the Mines de Lens, and the gas will be mixed with coke oven gas and sold to the City of Lille, while the low temperature tar and the smokeless fuel is available as usual, the small coal to be used having only a value of about 80 francs per ton. Since the end of the War the devastated area of Lens has been entirely reconstructed, the work having commenced in 1921, and the Mines de Lens at the present time turning out with the latest plant and equipment about 4,000,000 tons of coal per annum.

There has been installed for example, 14 screening machines, 5 washing machines with a total capacity of 400 tons of coal per 8 hours, 331 coke ovens with complete by-product installations in three batteries, and extensive equipment of briquetting machines, having a total capacity of 600 tons a day.

It is highly interesting, therefore, that a mine of this up-to-date character should now be installing a " K.S.G." low temperature carbonisation plant, which will have the effect of more than doubling the value of the present dust and smalls, and plans have been made to increase the size of the plant.

BRITISH SCIENCE GUILD.

Developments of British Chemical Manufactures.

SYNTHETIC DRUGS.

By Francis H. Carr, C.B.E.

An Address delivered at a Public Meeting at the Mansion House, London, on April 24, 1929.

(Continued from page 292.)

As a last example of recent achievement, let me refer to the discoveries in regard to Vitamin D. That part of the body which results in the hardening of its bony structure and teeth is promoted by a substance that is naturally produced in the body by exposure to sunshine. This can now be artificially made in an extraordinarily powerful form by the action of ultra-violet light on ergosterol—a substance derived from yeast. The manufacture of this Vitamin D was set up in this country very soon after the discovery was announced by Rosenheim and Webster, who carried out their researches in the National Institute for Medical Research. The rapidity with which this manufacture was commenced was due to the fact that the firm in question had for some years carried out research in the same field.

The substance has a most powerful action; indeed, a daily dose of 0.0001 mgm. suffices to produce complete healing of rickets in rats weighing 90-100 grams. Thus, one part appears to promote the deposition of very many thousand times its weight of calcium phosphate. In its complete absence healthy life cannot be sustained.

The new method of producing the vitamin artificially is by first manufacturing ergosterol from yeast and exposing it to radiations of the correct wave-length. The manufacture calls for the most careful scientific control of the process, and the product can only be tested by its effect on growing animals, rats being generally used for this purpose.

Under the artificial conditions of life the needed amount of vitamin D is sometimes not produced in the body, because the necessary radiations of short wave-length do not penetrate our polluted atmosphere, our darkened houses and thick clothing. Milk and butter constitute the chief dietetic sources of vitamin D, but the amount present is doubtfully sufficient and is subject to great variation. In consequence a great majority of our population suffers from vitamin D deficiency during winter months. This deficiency can easily and cheaply be met now that the production of

vitamin D by the irradiation of ergosterol on the large manufacturing scale has been achieved, and in consequence rickets and faults of dentition may rapidly be cured, or better *still, be entirely prevented by* administering it wisely. No considerations of the amount available or of its costliness—for it is extremely cheap—need hinder its addition to all supplies of margarine and to other suitable items of diet.

I have described these few synthetic drugs in order to show you the way in which our knowledge of chemistry and of the chemical changes of the body is developing and enabling the manufacturer to supply that which the physician requires. Little by little and year by year new knowledge is unfolding the secrets of the living process, and already it can clearly be foreseen that the final development of this knowledge will make it possible to beautify, strengthen and extend life by utilising the products of chemical synthesis.

There are many reasons why the manufacture of these fine chemicals is to be regarded as an industry of exceptional importance to us in Great Britain. It affords an outlet for the particular abilities of our race in scientific activity, and it makes for independence in applied science, without which our nation and empire cannot develop. Is it not, moreover, a condition of our existence that the industries suited to the race should be developed? Domination lies more with those who use knowledge than with those who discover it—most of all with those who both discover and apply new knowledge.

During the period 1860 to 1880 Great Britain led the way in the manufacture of medicinal chemicals, but whereas in regard to heavy chemicals we have continued to lead, there came a period during the last twenty years of the nineteenth century when the lead in the manufacture of the newly introduced medicinal chemicals and dyes was not maintained, while new departures in these fields were continually being made in Germany. It was fortunate that English manufacturers had already set out to recover this lead before 1914, when through the necessities of war a great strain was thrown upon their productive capacity. Building upon the new developments which had already begun, they were able, largely with improvised processes and plant, to supply every requirement of wartime; but after the war period there remained the problem of substituting for this improvisation manufacturing methods which were fully efficient, in order that competition from foreign countries might be met. For a time it seemed that, owing to the higher rates of wages in this country compared with those in Germany, success in this would be impossible. But in the end the situation was met by the Safeguarding of Industries Act, which has proved so instrumental that to-day we have recovered a great deal, if not yet all, of the ground which had been so disastrously lost. My own memory of the anxieties on account of supplies during the first years of war compels me to call attention to the strong need for always maintaining in the future a large measure of initiative and enterprise in this industry which was so nearly lost and which has been regained with such great difficulty.

To-day in Great Britain there are important manufacturing firms which between them are making most of the synthetic drugs. There do remain, however, some drugs that are not yet manufactured, as for example, guaiacol, phenacetin and veronal, though I am told that a well-known company intends soon to make the first of these. These exceptions are chiefly substances derived from intermediates employed in the making of dyestuffs. The manufacturers of dyes and of synthetic drugs have this common ground of using the same intermediate compounds, which, being made on a larger scale by the dye manufacturers, are more cheaply produced by them. The fact that substances of the type that I have mentioned are not yet manufactured implies that the organisation of chemical industry in this country, although it has made rapid strides, has not yet betn completed. The advantages of rationalisation in the fine chemical industry, by interconnecting and re-arranging the various branches in order to secure efficiency and the best development, at once becomes apparent when it is realised that most of the substances manufactured require specialised plant and accumulated experience. At the same time the market is easily overstocked, so that if much overlapping in manufacture occurs, plant becomes idle, skilled workers are not fully employed, and in consequence the cost per unit of production is not at the lowest possible level.

The changes which have occurred in chemical industry in late years are in large measure the result of the mutual approach and understanding which have already taken place between the business, the scientific, and the practical men in the industry, through the medium of their Association.

The more thoroughly this is carried into effect and continues in the future, the greater will be the rate of development.

Future progress lies in extending the use of science in our industry, in the first place by promoting research in industrial laboratories in the closest possible relation with that carried out in academic institutions and under the aegis of the Medical Research Council, and secondly, by finding employment for greater numbers of scientifically trained staffs and workers to whom is given responsibility and a living interest in the work they are performing. In this matter of trained personnel there has fortunately been a great increase during the past decade in the number of men receiving university training in chemical science. It is of great importance that as an outcome of the country's educational policy, many youngsters on leaving secondary schools in the present day have had sufficient grounding in elementary science for those who have an aptitude for it to be discovered. These youths on entering industrial laboratories in the chemical industry receive some sort of tutelage and practical training by day, and they supplement this by attending technical colleges by night. In this way a rank and file of able workers is being produced, with many new opportunities opening out for them.

It is an old and accepted tradition that the British workman is the best in the world. The truth of this is only to be maintained by findiug proper outlets for these scientific faculties, which are unquestionably characteristic of our race. The recognition of this, and the fact that as a nation we must live on productive industry, are strong reasons for developing and encouraging the manufacture of synthetic drugs.

RAYON—ARTIFICIAL SILK.

By A. B. Shearer

(*of Messrs. Courtaulds, Ltd.*).

Read to the British Science Guild at the Mansion House, London, on Wednesday, 24 April.

As there is a great deal of misunderstanding as to what is rayon, or as some people still call it " artificial silk," a definition is necessary. Rayon is " the generic name of filaments made from various solutions of modified cellulose by pressing or drawing the cellulose solution through an orifice and solidifying it in the form of a filament, or filaments, by means of some precipitating medium." " Artificial Silk " is quite the wrong name to call this wonderful new textile as it is no more " artificial " than is steel and many other manufactured products and it has none of the chemical and few of the physical characteristics of silk. The use of the expression " artificial silk " only keeps alive an erroneous impression of inferiority. All textile materials are named by short words and it was for that reason that the word " rayon " was introduced for the new textile industry, which is already more than three times the size of the old silk industry, and to-day ranks only after cotton and wool in importance. The four principal processes vary greatly in their chemical reactions and the machinery employed but they are all alike in the fundamental principle of producing a solution of cellulose, pumping the solution through fine holes or jets and, as it emerges, precipitating or coagulating the cellulose into continuous solid filaments or fibres.

In order of their industrial development the four processes are :—

(1) Nitro cellulose.
(2) Cuprammonium.
(3) Viscose.
(4) Cellulose Acetate.

Nitro cellulose was first used to produce a continuous thread by Sir Joseph Swan iu 1883 when he made his " artificial silk " for use as filaments in his gas-filled electric lamps but Swan fully realised the textile value of his filaments and in 1885 exhibited in Yondon fabrics made from his yarns. This was a year before Count Hilaire de Chardonnet took out his patent so that Chardonnet's chief claim to fame is not as the first inventor but as the first producer of rayon for textile purposes by establishing works in France, Switzerland, Belgium, and England. In this process the cellulose (usually cotton) is nitrated with a mixture of sulphuric and nitric acids. The cellulose nitrate is dissolved in a mixture of alcohol and ether and the resulting solution is spun either dry, that is into air, or wet, in which nase coagulation takes place in a water or salt bath. The resulting threads are afterwards denitrated with either sodium or calcium hydrosulphide. Owing to the expense of this process it is used to-day to a diminishing extent.

The Cuprammonium process, based upon Schweizer's discovery of 1887, was first used to produce filiments by Weston in 1882 but it was not developed commercially until after Pauly patented his process in 1897. In this process the cellulose, again usually cotton, is dissolved in " Schweizer's re-

agent," or ammoniacal cupric oxide solution. The resulting solution is then spun into a solution of caustic soda and the resulting filaments are usually stretched to increase the fineness and strength of the yarn. The copper is afterwards removed by washing the yarn with dilute sulphuric acid. This process is still used to a limited extent, especially for the production of fine denier yarns.

In 1892 Cross and Bevan, who had been systematically investigating cellulose reactions since 1880, discovered, and patented a method of forming a solution of cellulose which they called "viscose" because of its distinctive characteristic. This discovery only became industrially valuable after Topham, experimenting with Stern, discovered the effects of ageing and invented his method of spinning by means of a centrifuge. In this process cellulose (which can be either wood pulp or cotton) is steeped in a strong solution of caustic soda and the resulting alkali cellulose is treated with carbon bisulphide which converts it into a cellulose xanthatem a reddish gelatinous substance, soluble in water. The solution of cullulose xanthate, or viscose, after "ageing," to bring the solution down to the correct viscosity for squirting through the spinning nozzles, is coagulated in an acid bath. This is by far the most important process to-day and probably represents about 85 per cent. of the world's rayon production. It is generally considered that future developments will result from modifications and improvements of the viscose process.

The cellulose acetate process is quite unlike the other processes because the resulting yarn is a compound of cellulose, whereas all the other yarns are pure degraded cellulose with only slightly different physical characteristics resulting from their processes of manufacture. Cross and Bevan patented a process for cellulose acetate manufacture in 1894 but although it was investigated experimentally it achieved no practical success. Little in 1895 produced lamp filaments from cellulose acetate and Bronnert in 1899 made yarns experimentally but it was Miles, who in 1904 produced a cellulose acetate soluble in acetone, and several other solvents, who prepared the way for the later industrial elaborations. Since the war a number of works have been established to produce cellulose acetate yarns but the production is still a relatively small one. The cellulose is first acetylated with acetic anhydride and acetic acid in the presence of a catalyst such as sulphuric acid. The chloroform soluble cellulose acetate, which results, is not sufficiently strong for rayon. If water, however, is added to the reaction solution, and this is allowed to stand, a "ripening" takes place in which the cellulose acetate becomes degraded and then yields a secondary cellulose acetate soluble in acetone in which solvent it is used for rayon manufacture. The resulting spinning solution may be spun, like cellulose nitrate, either by wet or dry processes.

In a short lecture a detailed description of the industrial methods employed in these four processes cannot be given but enough has been said to indicate that their development upon a huge industrial scale must have had important reactions upon the chemical industry, especially in the production of sulphuric acid, carbon bisulphide, hydrochloric acid, caustic soda, sodium sulphide, acetic acid, acetic anhydride, copper sulphate and dyestuffs. Engineering has also been stimulated especially in making improvements in filtration, pumping, ventilation, and power transmission.

The manufacture of rayon is only possible as a result of the scientific developments of the last hundred years but it owes more to science for its amazing growth than has so far been indicated. The names of Swan, Weston, Cross, Topham, Chardonnet, Stern, Pauly, and others are generally associated with the establishment of rayon production but most people would be surprised if the names of Macadam, Watt, Dalton, Faraday, Perkin, Bessemer, Bell, Edison, Otto and Northcliffe were suggested as having an important influence in developing the rayon industry. The reason these names are suggested is not because rayon could not be produced without the discoveries of at least four of the men mentioned, but rather because our physical and mental environments which have resulted from their efforts have made rayon a necessity. The changes made have been more revolutionary for women than for men and consequently it is women who have been the first and greatest consumers of rayon. It is unnecessary to give more than a few of the effects of the discoveries that are indicated by the names given but in the main one can say that the last hundred and fifty years have seen the change over from primitive hand to modern chemica-mechanical production with a consequent enormous increase in real wealth spread through the community. Methods of transport have been enormously improved so that instead of the few travelling on horse-back by muddy or dusty tracks the

masses to-day journey in comfortable, well-heated railway carriages, or in closed road motors. Houses, offices, factories, hotels, theatres, cinemas, and dance halls are all so well heated, lighted, and ventilated, that we are to-day surrounded with a sub-tropical climate. Rapid movement and this warm atmosphere have compelled a reduction in the weight of our clothing and women especially, because of their greater mobility, have demanded greater freedom in the design of their clothing. Education, sport, and dancing have played their part and the cumulative result has been a demand for fewer, shorter, lighter, and brighter clothes. Such a demand could not be met by the older natural fibres as the only suitable textile was silk and that could not be economically produced at a price to meet the new demand. A new textile was necessary which would be at least as beautiful as silk and yet be capable of production in enormous quantities at a price which would make it possible for all women to obtain. The growth of the use of rayon need not be given in detail but to-day almost every item of clothing used by women and girls, from shoes to hats, contains a greater or less quantity of rayon. Two main uses should be mentioned, hose and underwear. Short frocks make good looking hose a necessity. With a reduction in bulk of clothing, frictionless, close-fitting underwear that can be easily washed and laundered is essential and rayon is the only textile which fulfils these requirements. The result has been that for foundation farments rayon is now everywhere recognised as the standard material. These garments are mainly the product of the knitting industry and the introduction of rayon has caused a surprising growth in that section of textile manufacture, a growth which has not yet reached its limit of development.

The industrial development of rayon has been quite as interesting as the laboratory discoveries which have been briefly described. Unfortunately this phase of the growth of an industry is not represented by patents and other public records and consequently much of the early history of the industry will certainly be lost. Many tried but few succeeded, and the few who finally triumphed were those who went forward with complete faith in a wonderful new textile material which they were determined at all costs to produce upon a commercial scale. Only those who succeeded are remembered, the many failures were never known to more than a few. Even to-day, after a passage of nearly forty years, the number of really successful firms is small. The difficulties of establishing an entirely new industry are seldom realised. It is not merely a question of selecting a convenient site and ordering your buildings and machinery. In a new industry laboratory formulæ have to be carefully extended for large scale production and methods of industrial application carefully thought out. Suitable machinery has to be designed, in many cases embodying entirely new principles. It must be placed to the credit of British organisation, business foresight, engineering skill, textile technology and salesmanship that this country has been able to take and maintain the lead in this great new industry. It was not only a question of producing a yarn that would hold together, the physical and chemical properties had to be investigated and developed to conform to the specific needs of various sections of the textile industry. The underlying idea in this country has always been that quality must always be improved and only those who have had experience in the use of the early products can fully appreciate how far ahead are the present yarns.

The specialities of to-day are usually the standard products of to-morrow. Something of the technical developments that have taken place can be judged from the fact that rayon warns can be produced that are two to three times stronger than the average yarn now in general use. The fineness of rayon warns, especially of the filaments or fibres of which they are constructed, has improved to an amazing extent during the past few years. To-day it is possible to produce commercially rayon yarns as fine as the finest silk and far finer than cotton. A pound weight of the finest denier yard spun to-day, contains about a hundred and seventy miles and filaments have been produced which are so fine that one pound would extend to over five thousand miles. The rayon filaments are far finer than have ever been spun by any silk worm.

The use of rayon has had an astonishing effect upon the general condition of the textile industries. The introduction of a new material has demanded a review of methods and has acted as a stimulus to those engaged in every branch. Especially has this been noticeable in bleaching, dyeing and printing. The new material has demanded better finishes than were given to the older textiles and the result is that the whole industry has benefited from the improved

methods and the better colours which are now available. There has also been a noticeable improvement in the production of new and finer fabrics. The workers themselves have changed for the better. Rayon requires more delicate treatment, manually as well as mechanically, excessive humidity is no longer an advantage but a detriment, and in the production of the new fabrics cleanliness is essential. All these new conditions have altered the environment in which textile operations are now carried out and these changes have in every case benefited the worker.

No official figures of employment in rayon production are available so that only estimates can be given. In the actual production of rayon about 25',000 workers are now directly engaged, but to this must be added engineers constructing the machinery, chemical workers producing the raw materials and the far greater numbers engaged in processing the yarn for manufacture, weaving, knitting, dyeing and finishing, and making-up for sale. If all these are included ,the number of workpeople in the British Isles dependent upon the rayon industry is probably at least 300,000.

There is another important economic consideration. Since 1924 (the duties were introduced in 1925) the production has doubled and in 1928 exceeded fifty million pounds weight. In this same period the imports fell from 10,318,000 lbs. in 1924 to 2,883,000 lbs. in 1928. The increased development in that short time has more than equalled the production attained during the previous eighteen years since the establishment of the industry in this country. As there is now a more or less definite ratio of workers to production this signifies that employment has doubled in a period of about three years. One other phase should be mentioned. All the cotton and silk we use is imported as is also at least 85 per cent. of the wool.. Of the cost of yarn, production in silk 100 per cent., and in wool and cotton from 50 to 60 per cent. is represented in imported materials. By contrast with these yarns the bulk of rayon produced in this country is 100 per cent. British as approximately 95 per cent. of the cost is expended in this country and the balance is chiefly accounted for in purchases from Canada of wood pulp.

Rayon is essentially the textile of the chemico-mechanical age we are now entering and there is every indication that in the future, as in the past, this country will play its appropriate part.

THE ANNUAL MEETING OF THE CANADIAN INSTITUTE OF MINING AND METALLURGY.

In point of attendance and in point of enthusiasm seldom, if ever, has an Annual Meeting of the Canadian Institute of Mining and Metallurgy excelled that held in Winnipeg on March 6—8 of this year. It was the first annual meeting to be held west of the Great Lakes and the mining engineers of central and western Canada showed great appreciation of the opportunity offered.

It was very fitting that the meeting be held this year in Winnipeg. It is a milestone in the history of mining in Canada. It marks an awakening of the mining consciousness of a province, for on account of recent developments particularly in the Flin Flon and Kississing Lake areas and in the east central part of the Province, Manitoba now stands on the threshold of important mining and metallurgical operations.

Papers were presented setting forth the present status of the mining industry of Canada and announcing an increase of ten per cent. in the value of mineral production for 1928 over that for 1927. In 1928 the total value was £56,264,787. Among the world's producers Canada now ranks first in nickel, first in asbestos, second in cobalt, third in gold, third in silver, fourth in lead, fourth in copper and sixth in zinc.

Many of the papers read before the Institute had to do with exploratory work in search of mineral deposits in new areas or with the character of new deposits in the course of development. One described methods adopted in the use of the aeroplane in carrying on explorations, two contained descriptions of explorations on the south shore of Great Slave Lake, one described conditions in Northern British Columbia favourable to the occurrence of mineral deposits, one contained a description of a large ore-body in northern Manitoba now under development, one gave a general description of the mode of occurrence of the ore-bodies found in the Pre-Cambrian rocks of Canada, one described a new method of treating clays to overcome drying defects, one set forth the oil and gas situation in the Prairie Provinces, and one explained the functions of the Dominion Department of Mines in the development of the mineral industry. All indicated a hopeful attitude of mind, a far look into the future anticipating great and growing developments. The feeling of optimism was prevalent and it may safely be said that never in the history of the industry was the outlook brighter than it is to-day.

GENERAL NOTES.

PROFESSOR COWELL ON DIETETICS.

Professor S. J. Cowell, Professor of Dietetics in London University, in the first of a series of six lectures on dietetics at St. Thomas's Hospital on May 2, said that dietetics concerned every human being and determined to a considerable extent our state of domestic happiness or the reverse. It was a subject which had ethical, æsthetic, and economic aspects, but he intended to emphasise the physiological aspect in the lectures. He wished to trace the modern conception of nutrition which led to the view that what had previously been considered the main components of diet—proteins, fats, carbohydrates, and mineral salts—were not the sole essential constituents of the normal diet. That had paved the way to modern views which had done so much towards the prevention and treatment of disease. The advance in the science of nutrition had been attained also by the method of clinical observation, and it was the combined efforts of the exponents of the method of chemical and physiological analyses on the one hand, and of clinical observation on the other, that had led to the most fruitful of our practical methods of preventing and treating disease.

Dealing with the physiological action of the main tissue-building and energy-providing constituents of the normal diet, he said that the most ideal combination of those substances would fail to support life and would lack those essential accessory food factors, or vitamins, which were known to be required to complete the diet. It was better to postpone the thoroughly complicated question of white versus brown bread until they had considered more fully the distribution and mode of action of the vitamins and other factors concerned. It was unfortunate that those things which contained the greatest content of vitamins were found in dairy produce, which was beyond the means of a large section of the population. The palate itself was not a reliable selective organ for food under these highly civilised conditions.

BOARD OF TRADE ANNOUNCEMENT.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

APPLICATIONS FOR LICENCES IN APRIL, 1929.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 734, of which 652 were from merchants or importers. To these should be added 14 cases outstanding on the 30 March, making a total for the month of 748. These were dealt with as follows :—

Granted—700 (of which 686 were dealt with within 7 days of receipt.)

Referred to British Makers of similar products—36 (of which 23 were dealt with within 7 days of receipt.)

Outstanding on 30 April—12.

Of the total of 748 applications received, 709, or 95 per cent., were dealt with within 7 days of receipt.

DEPARTMENT OF OVERSEAS TRADE.

The Commercial Counsellor at Buenos Aires (Mr. H. O. Chalkley, C.B.E.) has forwarded to the above Department a short report on the possibilities for the sale of British machinery, implements, etc., for use in connection with the wine industry of the Province of Mendoza, Argentina.

A copy of the report may be obtained by any firms interested in the export of wine-making machinery and requisites of British manufacture on application to the Department at 35, Old Queen Street, London, S.W.1.

TWELFTH EXPOSITION OF CHEMICAL INDUSTRIES, NEW YORK.

The opening of the Twelfth Exposition of Chemical Industries at 2 p.m. on May 6, at rand Central Palace, New York City, was one of the outstanding events of the year in the industrial world.

This Exposition has become a feature in industry and is not alone a clearing house for the chemists and engineers in the sense of comparative value of the products, practices, and chemical engineering developments, but permits the prospective purchasers in the field to make direct comparisons of the products in which they are interested.

The 400 various exhibits of chemicals, machinery ,equipment for handling raw and finished products, instruments of precision and control, and the various sectons and divisions of the Exposition will have a large percentage of exhibits that are new and should attract much attention from the visiting chemists, engineers, and industrial executives who attend the Chemical Show

for the purpose of inspecting the latest in the chemical industrial field. There are Students' Courses under Professor W. T. Read of the Texas Technological College. These courses are divided into two sections; the first course is for those who have had elementary chemistry, but no training or experience in chemical engineering and deals in a clear simple manner with unit operations and equipment. The second course includes lectures of more advanced nature on unit chemical engineering operations and is primarily intended for advanced undergraduates, graduate students, teachers of chemical engineering.

CANADIAN NATIONAL RESEARCH COUNCIL'S ACTIVITIES.

H.M. Senior Trade Commissioner in Canada and Newfoundland has forwarded a statement reviewing the activities of the National Research Council, Ottawa, during the official year 1927-28.

In addition to its general responsibilities, the National Research Council is assigned by the Research Council Act the duties, among others, of promoting the utilisation of Canadian natural resources; conducting researches into industrial technical processes and methods; investigating and determining standards and methods of measurements, etc.; standardising of scientific and technical apparatus and instruments, and determining standards of quality of materials used in public works construction and the Government service; and making researches for the improvement of agriculture.

The work of the Council during the past year included the organisation and stimulation of co-operative research work on major problems through associate research committees; stimulation of research work by research grants for special squipment or technical assistance to qualified research men working in established laboratories, and post-graduate training of research workers by the award of graduate scholarships in science and research to graduates who have completed a university course in science with distinction.

At the close of the year there were organised, under the National Research Council, 24 associate committees with a total membership of 363, all of whom gave their time and experience without remuneration. There were also in active operation in laboratories from coast to coast 88 specific investigations, each directed without remuneration by a highly trained specialist. At the same time 48 post graduate research scholarships were also in active operation under the Council's auspices with the object of training outstanding university graduates in science and research, in order to build up in Canada a corps of men thoroughly qualified to undertake such work.

The total research organisation actively at work under the National Research Council numbered 570, of whom 465 persons served without remuneration. Since the close of the official year 750,000 dollars has been provided by the Canadian Parliament as an initial vote for the erection of national research laboratories.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Under the Order in Council dated 6 February, 1928, the Lord President of the Council has appointed Sir James Alfred Ewing, K.C.B., LL.D., D.Sc., F.R.S., M.Inst.C.E., to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, to fill a vacancy occasioned by the death of Mr. Robert Whyte Reid, C.B.E., M.I.M.E.

COAL SOLD BY HEAT UNITS.

Scottish Smokeless Fuel Innovation.

Smokeless fuel—guaranteed, like the gas supply, to produce a fixed maximum of heat units per ton, and to contain a minimum of ash content—will be placed on the market early this summer, when the world's biggest low temperature coal distillation plant, being erected for the Bussey Company at Glenboig, near Glasgow, is in operation.

This innovation has been made possible as a result of special research on Scottish coals carried out by Dr. H. B. Cronshaw, the company's consulting chemist, in London. The new plant will produce over 400 tons of fuel daily.

" Buying coal has been more or less a gamble to the public up to now," stated Dr. H. B. Cronshaw in an interview. " With few exceptions one can never guess what the next ton—or bag for that matter—will be like. It may burn brightly, give intense heat, and leave little ash; on the other hand, it may be everything that coal should not be. Our new scheme will obviate this entirely. The housewife will know exactly what she is buying."

CORRESPONDENCE.

A PREPARED MILK PATENT.

To the Editor of the CHEMICAL NEWS.

Dear Sir,—It may interest you to know that I have invented the first patented process for preparing fresh milk of almost any desirable chemical composition.

In that patented process the following most important points are embodied :—

1. The chemical composition of the milk prepared by this method is very near to the composition of human milk.

2. The series of condensed milk so manufactured contain water and fat, as well as the other substances, in any desired quantities, and the milk remains as if fresh (for instance, it is possible to get a condensed milk with increased amounts of fat).

The main feature of these milk products is that all the vitamins and the specific milk properties remain unimpaired.

At present no such products are on the market.

These milk products have been tested by the medical authorities in a few hospitals and sanatoriums, and I have many references from doctors and specialists showing that from the medical standpoint my products are very useful.

As I know, the dairies are really in opposition in view of possible competition; and are afraid that the introduction of these methods to practice would necessitate changes and improvements in milk regulation, they see that such milk products are more valuable as a human food, and would be an object of competition with pasteurised milk.

Since I am not a business man and not a capitalist, I am looking for someone who would be in a position to undertake an enterprise for the production and exploitation of my inventions.

I would be much obliged to you if yon can find a business partner among doctors, dairymen, farmers, or others, who would take an interest in my patents and realisation of my invention.

I am very truly yours,

VIKTOR V. WINTER,

Engineer-Technologist.

Prague, Dejvice,

Urednická, 386.

The Manchester Municipal College of Technology has just issued a new (Summer) Prospectus of Short Courses of Lectures and Laboratory Work to be given there during the summer months.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Papers read on Thursday, May 9 :—

Magnetostriction and the Phenomena of the Curie Point. By R. H. FOWLER, F.R.S., AND P. KAPITAZA.

Various physical consequences of Heisenberg's theory of ferro-magnetism are discussed—in particular the change of specific heat and of length at the Curie point and the phenomena of magnetostriction. It is shown how all these phenomena are related together in the light of the theory. In particular it is shown that the phenomena require the interaction integral, called by Heisenberg J_0, to increase with the volume of the crystal at least over a small range of value, covering the normal value for iron, and the consequences of this somewhat unexpected requirement are discussed.

A Collision Problem in the Wave Mechanics. By C. G. DARWIN, F.R.S.

In the quantum theory one method of procedure is to regard the motion of matter as a wave motion, but this motion must be *interpreted* in terms of particles in order to describe what is observed. Motions can be imagined which seem to imply particles in cases where they are not directly observed. An ideal experiment of this kind is devised, depending on collisions between two free bodies, and it is shown that the particle-like behaviour is given just as successfully by the wave theory. This implies that the interpretation can sometimes be postponed, and there follow speculations as to the consequences of this postponement in the general theory.

The Relativistic Theory of an Atom with Many Electrons. By J. A. GAUNT. Communicated by R. H. Fowler, F.R.S.

The total angular momentum of the atom, suitably defined, has the same properties as in the non-relativistic theory. The inner and magnetic quantum numbers, and their selection rules, can therefore be taken over into the new theory, and the selection rules are rigorous in the absence of external fields. The selection rule that $\Delta\Sigma k$ is odd is proved for an atom in a uniform magnetic field. By means of wave mechanics the azimuthal quantum number is defined and its relation with the other quantum numbers deduced. The summation rule is valid when terms of the order of the spin effects are negligible.

The Quantum Theory of Dispersion in Metallic Conductors. By R. de L. Kronig. Communicated by R. H. Fowler, F.R.S.

The Interpretation of the Wave Equation for Two Electrons. By N. F. Mott. Communicated by R. H. Fowler, F.R.S.

The Criterion for Turbulence in Curved Pipes. By G. I. Taylor, F.R.S.

The Influence of Hydrogen Ion Concentration on the Absorption of Weak Electrolytes by Pure Charcoals. By H. J. Phelps and R. A. Peters. Communicated by Sir Harold Hartley, F.R.S.

Hydrogen ion concentration greatly influences adsorption upon purified charcoal of various organic acids and bases, and of some amino acids. The degree to which propionic, caproic and succinic acids are adsorbed is roughly in inverse ratio to the degree of ionisation at any particular C_H. From alkaline solutions these acids are not adsorbed. Adsorption of butylamine and of propylamine is maximal in alkaline solutions, falling to zero in more acid solutions. Correspondence between ionisation and adsorption is in these cases less marked. Some mono-amino acids studied show very slight adsorption at any C_H, which does not appear to be consistent with classical views of the ionisation of these bodies. Comparison of effect of C_H upon adsorption of histamine and histidine indicates that histamine is completely adsorbed in alkaline solution, whereas adsorption of histidine tends to be depressed. In solutions more acid than pH 7.8, the curves for the two substances are identical. Adsorption proceeds predominantly through un-ionised molecule.

The Third Positive Carbon and Associated Bands. By R. K. Asundi. Communicated by O. W. Richardson, F.R.S.

The Kinetics of the Oxidation of Copper. Part I. By F. J. Wilkins. Communicated by T. M. Lowry, F.R.S.

Analysis by X-ray Spectroscopy. By C. E. Eddy, T. H. Laby, and A. H. Turner. Communicated by Sir Ernest Rutherford, P.R.S.

The Adsorption of Hydrogen on the Surface of an Electrodeless Discharge Tube. By M. C. Johnson. Communicated by S. W. J. Smith, F.R.S.

The Absorption Band Spectrum of Chlorine. By A. Elliott. Communicated by T. H. Havelock, F.R.S.

The Influence of Nitrogen Peroxide on the Combination of Hydrogen and Oxygen. By H. W. Thompson and C. N. Hinshelwood. Communicated by Sir Harold Hartley, F.R.S.

The First and Second Order Equations of the Quantum Theory. By H. T. Flint. Communicated by O. W. Richardson, F.R.S.

The Magnetic Anistropy of Naphthalene Crystals. By S. Bhagavantam. Communicated by C. V. Raman, F.R.S.

Perturbation Theory in Quantum Mechanics. II. By A. H. Wilson. Communicated by R. H. Fowler, F.R.S.

On the Stability of Unimolecular Films. Parts I, II and III. By C. G. Lyons and E. K. Rideal. Communicated by Sir William Hardy, F.R.S.

Quantum Mechanics of Many-Electron Systems. By P. A. M. Dirac. Communicated by R. H. Fowler, F.R.S.

The Spectrum of H_2. The Bands Analogous to the Parhelium Line Spectrum. Parts III and IV. By O. W. Richardson, F.R.S., and P. M. Davidson.

The Suspension of Sand in Water. By H. E. Hurst. Communicated by G. C. Simpson, F.R.S.

The Transfer of Heat by Radiation and Turbulence in the Lower Atmosphere. By D. Brunt. Communicated by G. C. Simpson, F.R.S.

Hydrodynamic Forces acting on a Cylinder in Motion, and the Idea of a "Hydrodynamic Centre." By W. G. Bickley. Communicated by G. I. Taylor, F.R.S.

The Action of Metastable Atoms of Helium on a Metal Surface. By M. L. E. Oliphant. Comminucated by Sir Ernest Rutherford, P.R.S.

The Effect of a Nuclear Spin on the Optical Spectra. By J. Hargreaves. Communicated by R. H. Fowler, F.R.S.

New Methods in Statistical Mechanics. By M. N. Saha, F.R.S., and Ramash Chandra.

THE PHYSICAL SOCIETY.

Papers read on Friday, May 10 :—

Heaviside's Fractional Differentiator. By W. E. Sumpner, D.Sc., M.I.E.E.

The paper dealt with (1) Heaviside's experimental methods; (2) the index operator, its definition and justification; (3) its use with Leibnitz's theorem; (4) its use with binomial and exponential expansion; (5) functions of the operator; (6) Heaviside's operators; (7) the impulse function.

A Simple Method of Fitting a Straight Line to a Series of Observations. By J. H. Awbery, B.A., B.Sc., Physics Department, The National Physical Laboratory.

A method is described for determining the constants in a straight line to represent a series of data. It has a rational basis, and can be carried out in one-third or one-quarterof the time required to apply the method of least squares; it avoids the multiplications and squarings essential to that method, and has the advantage that it does not at any stage require the use of more significant figures that are presented in the data to be analysed. The results of the method are compared with those obtained by that of least squares, on some accurate, and also on some very scattered, observational material. In both cases, the saving of time and labour lead to a negligibly small decrease in accuracy, as compared with the older method.

Arc Spectra in the Region λ1600-λ2100. By E. W. H. SELWYN, B.Sc.

A simple method is described of photographing ordinary arc spectra down to about λ1600 and measures are given of the spectra thus observed between λ1600 and λ2100 of thirteen elements. The measures are believed to be of an accuracy sufficient to make them useful as provisional standards of wave-length. A number of lines hitherto unobserved is recorded and additions have been made to the analysis of the spectra of Mg 1, Be 1, and B 1.

The Spectrum of Trebly-ionised Thallium. By K. R. RAO, D.Sc., Imperial College of Science.

Using the measurements made by Carroll of the Vacuum Spark Spectrum Thallium, combinations of the triad of triplet and singlet *F*, *D*, *P* terms of the d^9p configuration of Tl IV with the deeper ^3D and ^1D of the d^9s state have been found. Justification o fthe scheme is sought by comparison with similarly constituted spectra.

The Elastic Properties of Thick Cylindrical Shells under Internal Pressure. By G. A. WEDGWOOD.

An account is given of an experimental investigation of the usually accepted theory relating to the stresses in a thick cylindrical shell under pressure. The theory is examined in the light of the longitudinal and diametral extensions of a number of steel cylinders which were subjected internally to hydrostatic pressure, the cylinders being closed at the ends by covers secured to the shell itself.

A joint meeting of the Physical Society and the Society of Glass Technology was held on Tuesday, May 14, at the Research Laboratories of the General Electric Co., Ltd., Wembley. The following papers were read :—

A Study of the Thermal Expansion of Glass up to the Softening Temperature. By PROFESSOR W. E. S. TURNER, O.B.E., D.Sc., F.Inst.P., AND F. WINKS, M.Sc.Tech.

The Measurement of the Viscosity of Glass at High Temperatures by Means of the Rotating Cylinder Viscometer. By R. F. PROCTOR, B.Sc., A.M.I.E.E., AND R. W. DOUGLAS. (A communication from the Staff of the Research Laboratories of the General Electric Co., Ltd., Wembley.)

The Photo-Elastic Properties of Glass. By F. C. HARRIS, M.Sc., Department of Applied Mathematics, University College, London.

VISITS.

The Research Laboratories of the General Electric Co., Ltd., at Wembley, were open for inspection before the meeting.

After the meeting, the neighbouring Glass Works of the Osram General Electric Company were visited, by courtesy of the Manager, Mr. W. Warren, A.M.I.C.E., A.M.I.E.E.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

At a Meeting at the House of the Royal Society of Arts, John Street, Adelphi, W.C.2., on Tuesday, 14 May, the following paper was read :—

Flame Characteritics of " Pinking " and " Non-Pinking " Fuels. By G. B. MAXWELL AND R. V. WHEELER, D.Sc., M.Inst.P.T.

ROYAL INSTITUTION.

A General Meeting of the Members of the Royal Institution was held on May 6, Sir Robertson, Treasurer, in the chair. The chairman announced that the Duke of Nortrumberland (President) had nominated the following as Vice-Presidents for the ensuing year : Lord Blanesburgh, Sir James Crichton-Browne, Dr. W. H. Eccles, Sir Arthur Keith, Mr. C. H. Merz, Dr. G. C. Simpson, Sir Robert Robertson (Treasurer), and Major C. E. S. Phillips (Secretary). The Special Thanks of the Members were returned to Sir Dugald and Lady Clerk, Lady Dewar, Mr. T. H. Sowerby and Mr. A. A. Campbell Swinton for their donations to the Special Fund for the alterations in the building. Sir J. J. Thomson was elected Honorary Professor, and Sir Ernest Rutherford, Professor of Natural Philosophy. Mr. C. E. R. Brocklebank and Mr. F. L. Pearson were elected Members.

SOCIETY OF PUBLIC ANALYSTS.

An Ordinary Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, May 1, the President, Mr. Edward Hinks, being in the chair.

Certificates were read for the first time in favour of John William Haigh Johnson, M.Sc., F.I.C., Mamie Olliver, B.Sc., A.I.C., and George Edward Sraw, B.Sc.

Certificates were read for the second time in favour of Alfred Norman Leather, B.Sc., F.I.C.; Richard Harold Morgan, B.Sc., A.I.C.; and William George Painton, B.Sc., A.I.C.

The following were elected Members of the Society:—Peter Trevisa Clarke, B.A.; Alfred Clive James, B.Sc., A.I.C.; Herman Lee, B.Sc., A.I.C.; James Frederick Morse; Lawrence John Odling; Willie Horner Wilkinson.

The following papers were read and discussed:—

The Determination of Organic Peroxides. By R. S. Morrell, M.A., Ph.D., F.I.C., and S. Marks, M.Sc., A.I.C.

Fahrion's methods of determining the peroxide oxygen in oxidised linseed oil by measuring the iodine liberated from potassium iodide in the presence of sulphuric acid ras been studied by means of pure benzoyl peroxide and other peroxides. The effect of varying the conditions has been investigated, and a modified method has been devised which gives concordant results with oxidised vegetable oils and their recomposition products.

Differential Halogen Absorption of Oils and Fats. By J. W. Croxford.

Tom's bromine vapour method of determining the halogen absorption of oils gives rapidly the true iodine value of certain oils and fatty acids which require very many hours for complete absorption of the Wijs reagent. Fatty acids and oils of the oleic acid series with the double bond adjoining the carboxyl group, *e.g.*, crotonic acid, tiglic acid and croton oil, may thus be recognised by the difference in the results obtained by the two absorption methods. On the other hand, the iso-oleic acids formed in the hydrogenation of oils, and the petrosilinic acid of parsley seed oil, give similar results by the two methods, and have thus the double bond at a distance from the carboxyl group.

A New Method for the Separation of Small Quantities of Tantalum and Niobium from Titanium. By W. R. Schoeller, Ph.D., and C. Jahn.

The solution containing the oxalates is treated with sodium salicylate, which converts the titania into a stable crystalloidal sodium titanylsalicylate. The earth acids are then precipitated with calcium chloride, the precipitate dissolved in hydrochloric acid, oxalic acid destroyed with permanganate, and the earth acids precipitated with tannin. After repetition of the process very little of the earth acids escapes precipitation, and an empirical correction is made for this. Finally the earth acids are converted into pentoxides, which are practically free from titania.

The Analysis of Small Samples of Gas. By H. R. Ambler, B.Sc., A.I.C.

Apparatus for the analysis of small samples of about 1 c.c. of gas, in which rubber connections are abolished. The volume of absorbent reagent is reduced, and the sensitiveness of reading increased. Typical analyses with the use of this apparatus are described.

NOTICES OF BOOKS.

A Reference Book of Inorganic Chemistry. By Wendell M. Latimer (Associate Professor of Chemistry in the University of California) and Joel H. Hildebrand (Professor of Chemistry in the University of California). Pp. viii + 442. Price 16s. New York: Macmillan and Company.

This is an excellent handbook, which aims at filling a want in the teaching of chemistry in the California University. It will, we believe, achieve the object aimed at by the authors, who, no doubt, regard their labour as one of love for and loyalty to their University. The book deserves a wide circle of readers, not only students but more mature votaries of Science.

A New School Chemistry. By F. Sherwood Taylor, M.A., B.Sc., Chemistry Master, Gresham's School, Holt (Late scholar of Lincoln College, Oxford). Pp. 502. Price 5s. London: Dent & Sons., Ltd., 10/13, Bedford Street, W.C.2.

This is a concise and useful hand book for the student who is ambitious to win his matriculation honours at the earliest possible date. It is a book which is the result of the practical experience of the author, and will prove very helpful to the student and also to the teacher, as calculated to relieve him of a good deal of lecture notes and other drudgery. The author acknowledges the valuable assistance of a number of prominent chemists, especially Dr. E. J. Holmyard, of Clifton College.

Hydro-Extractors (Studies and Reports Series F, No. 3, International Labour Office, Geneva. Published in the United Kingdom by P. S. King & Son, S.W.1. 1929. Price 4s.

That branch of the League of Nations concerned with Social and Industrial Welfare (the International Labour Office at Geneva), has issued a number of monographs on the prevention of accidents in industry. In this the co-operation of a number of Governments and interested individuals have been secured to augment the usual channels of enquiry in compiling information of this kind.

Messrs. Blagg and Johnson, Ltd., Newark-on-Trent (Notts.), have issued a Catalogue of their sheet-metal specialities. The Catalogue will be sent gratis to readers of the *Chemical News*.

The illustration shows the type of tinplated goods that these manufacturers are engaged in producing in increasing quantities.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, June 26, at 4 p.m.—Annual General Meeting.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

The next Ordinary Meeting of the Society will be held on Wednesday, October 16, 1929, when the Annual Pond Life and General Microscopical Exhibition will be held.

The next meeting of the Biological Section will be held on Wednesday, November 6, 1929.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 19 to September 14, 1929.

U.S. PUBLICATIONS RECEIVED.

GEOLOGICAL SURVEY.

Surface Water Supply of the United States. Part. IX.

Colorado River Basin. By Nathan C. Grover and R. Follansbee, A. B. Purton, and W. E. Dickinson. Price 25 cents.

Geology of Reservoir and Dam Sites. By Kirk Bryan. 30 cents.

Preliminary Report on the Sheenjek River District, Alaska. By J. B. Mertie.

Surveys in N.W. Alaska in 1926. By Philip S. Smith.

Platinum and Black Sand in Washington. By J. T. Pardee.

Mineral Industry of Alaska in 1927. By P. S. Smith.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

12,415.—Chemieverfahren Ges. — Production of alkali sulphates. April 22.

13,055.—Fraser, J. P.—Manufacture of hydrogen. April 26.

13,150.—Hansen, C. J.—Decomposition of thiocyanic acid ,etc. April 27.

12,420.—I. G. Farbenindustrie Akt.-Ges. Production of high percentage manganese dioxide. April 22.

12,777.—Kauba, F.—Method of recovering zinc sulphide from zinc-containing liquids. April 24.

Specifications Published.

310,074.—Soc. of Chemical Industry in Basle, and Miescher, K.—Manufacture of basic derivatives of substituted quinoline-carboxylic acids.

307,037.—Union Chimique Belge Soc. Anon. —Process of producing ammonium sulphate by the treatment with gypsum of an ammoniacal solution used for the scrubbing of gases.

310,230.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges).—Process for the production of alkali nitrates from alkali chlorides.

310,276.—Kunstdunger - Patent - Verwertungs-Akt.-Ges.—Method of producing a mixture of calcium nitrate and ammonium nitrate.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

307,531.—Dyes, intermediates.—Carpmael, A., 24, Southampton Buildings, London.

Sulphonic acids of N-acetoacetyl arylamines are obtained by sulphonation of the acetoacetylarylamines with the exclusion throughout the reaction of water or agents containing water. In examples, acetoacetanilide and *o*-chloracetoacetanilide are sulphonated with 3 to 5 times the quantity of 20 per cent. oleum at about 10° C. Sulphuric anhydride is also mentioned as a sulphonating agent, and the acetoacetyl derivatives of *p*-anisidine, *as-m*-xylidine, *o*-toluidine, and the naphthylamines as starting materials.

Azo dyes.—Sulphonated acetoacetanilide gives by coupling with diazotised aniline a yellow dye, and with diazotised sulphanilic acid a reddish yellow dye.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

OLIGODYN.

498,332.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Oligodyn-Aktiengesellschaft, The Eidgenossisches Postgebaude, Zug, Switzerland. May 1.

KATADYN.

498,336.—All goods in class 3 which includes chemical substances prepared for use in medicine and pharmacy.—Oligodyn-Aktiengesellschaft, The Eidgenossisches Postgebaude, Zug, Switzerland. May 1.

"CHEMICAL NEWS"—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, "CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.
By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

URGENTLY WANTED TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.
also
No. 3400. Vol. 130.

Double Price Paid.

Address—R. M. P., *c/o Chemical News*, Merton House, Salisbury Square, London, E.C.4.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3606.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

The Separation of the Components of Frozen Milk by Fractional Melting 321
By Viktor V. Winter.
Recombination Spectra of Ions and Electrons in Caesium and Helium 325
By F. L. Mohler and C. Boeckner.
Fertilisers from the Air ... 327
By Sir Frederick Keeble, C.B.E.
General Notes—
Glass Ware ... 328
Imperial Chemical House Architect ... 329
Mental Diseases and the Public ... 329
Proceedings & Notices of Societies:—
The Chemical Society ... 331
Royal Agricultural Society ... 332
The Optical Society ... 332
The Chemical Society of Japan ... 333
An Outline of the History of Medicine in India ... 333
By Capt. P. Johnston-Saint, M.A.
Forthcoming Events ... 335
New Patents ... 335
New Trade Marks ... 336

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

THE SEPARATION OF THE COMPONENTS OF FROZEN MILK BY FRACTIONAL MELTING.

By VIKTOR V. WINTER.
(*Technical Engineer.*)

In May, 1926, I wrote an article, where I outlined the phase division of milk plasma during the fractional melting of frozen milk.

The article has not been published up to now for various reasons, although all the authorities who have perused its contents have taken a keen interest in it because there are new communications which may be made use of scientifically as well as practically.

From personal intercourse as well as from my correspondence with the authorities in physical chemistry I gathered that there does not exist any theoretical treatise, nor are any experiences known regarding the phase division of the matters dissolved simultaneously in solution, emulsified and suspended during the freezing and fractional melting of the original system of the components co-existing in the solution.

The behaviour of the solutions which contain more than two components, during the freezing, as well as the quality of their different components has already been dealt with, though not very extensively. Since research has not yet been continued in the said direction the view is held that during successive meltings the rate of the dissolved, emulsified, solid and suspended matter always remains the same with all fractions, or on the contrary, that after melting, only pure water it obtained at the beginning.

Further work[1] has afforded sufficient material for the study of this question.

Of the milk components, *viz.*, fat, protein, lactose and salts, the public are chiefly interested in the fat. The methods of obtaining milk rich in fat (cream) by prolonged standing or by centrifugal movement are well known.

The other components dissolved in milk or suspended in milk do not interest the public very much; the degree of the density (or thinness of milk) is always considered only with regard to the fat percentage contained in the milk, and the quantity of the milk plasma is hardly spoken of.

The other chief components, as proteins (curd, cheese) as well as lactose are now isolated by technical processes. However, the products obtained by the well-known technical processes are no more substances

[1] First patent in Finland, No. 10896, and second in Czechoslovakia, No. 24,886.

which possess those physical and chemical qualities as they have in the natural fresh milk.

Up to now the division of the contents of the fundamental components, *viz.*, proteins, sugar and salt, in the fresh natural[2] milk has not yet been sufficiently made use of technically, although in some work[3] the separation of the milk plasma (a dry substance devoid of fat) has been referred to.

This is attained by the freezing process and further from the present work, by the fractional melting, too.

The inhabitants of cold regions and places are well aware of the fact that with the melting of formerly frozen milk the qualities of the fresh milk, as it was before the freezeing, are maintained unchanged.

The freezing of milk may be performed partially as described in the technical literature[4] and as has been done in all cases up to now.

The chief defect in incomplete freezing, however, lies in the fact that it is very difficult to obtain the same results in different cases and under different circumstances. I have therefore employed chiefly the entire milk-freezing system of Kohonaan.

Of all the fundamental components of milk, the division of the fat contents is in my opinion, from the theoretical as well as practical point of view, of no special importance. Based on the material gathered from experiments, I maintain the fat contents in the fractions of re-melted milk may be made dependant on the conditions of the freezing and re-melting as well as on other circumstances according as shown in the diagrams, Figs. 1, 2 and 3.

From these diagrams it is evident that in all fractions of the successive re-melting, the fat contents appear to be most equal in the middle diagram. The left diagram shows a greater quantity of fat at the beginning. Again, the right diagram shows a greater quantity of fat at the beginning as well as at the end of the re-melting.

The indicated types of changes of the fat contents in the milk are technically of no importance, because there are known variations in fat quantities which are more easily given than in the centrifugal process.

[2] With the addition of water the milk becomes artificial.

[3] *i.e.*, Vieth, Kaiser, Schnieder, Bordas and Raczkovsky.

[4] See short contents in *Handbuch der Milchkunde*, by Dr. Sommerfeld, and in *Die Milch und Molkereiprodukte* (Stohmann).

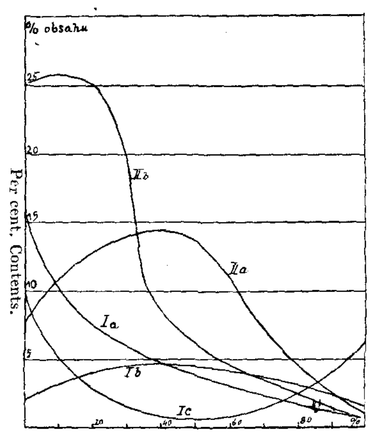


Fig 1.

Instead of that the contents of the fatless dried substance (the so-called plasma : proteins + sugar + salt), are technically and, I suppose, scientifically much more important.

Based on my tests the division of the milk plasma during fractional melting may take place according to two standards indicated in Fig. 2.

The second standard of the division of the milk plasma is more useful than the first for two reasons, *viz.* (1) The maximum quantity of milk plasma is obtained at once, (2) the maximum of the second standard is greater.

However, the standard shown in the first diagram would be of technical importance especially when fresh non-artificial children's milk is to be obtained, which with regard to its technical composition approaches mother's milk.

The division of the contents of the plasma as a unity as well as of its chief components (proteins, sugar, and salt), according to different fractions would likewise be interesting in the case even, where no closer specification of the components of the proteins and salts is taken into consideration.

It is very difficult to tell in advance according to which diagram the division of the contents of each of these three com-

ponents of the milk plasma will be directed. The debates on this subject with experts who have shown interest in it have led to different results. However, to my question : " Which of these three components will separate into fractions most equally ? " I have received nearly always the same reply, corresponding with my former opinion, namely, that probably this will be the proteins, because they are in the colloidal condition. According to the theory of probability we might have expected that all the three components will separate into fractions according to the original proportions.

Likewise, Vieth has found that the original proportion of these components is very stable and he says that the quantity of proteins in relation to the quantity of sugar and salt is 10 : 13 : 2 (total, 25). This proportion may also be called Vieth's proportion.

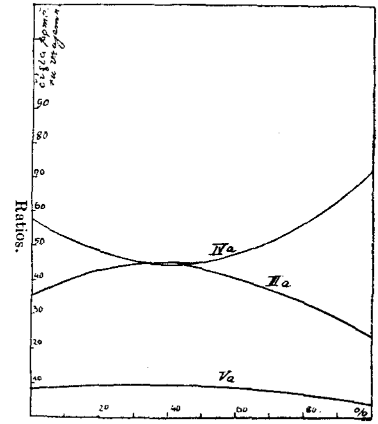


Fig 2.

I have often observed this proportion of the components in cow's milk, and not only according to my own analysis but also according to the analysis of other authors and I have arrived at the average percentage proportion 89 : 52 : 9, and not to the proportion 40 : 52 : 8, as it has been the case with the transferring of Vieth's particular proportion to the proportion expressed in percentages.

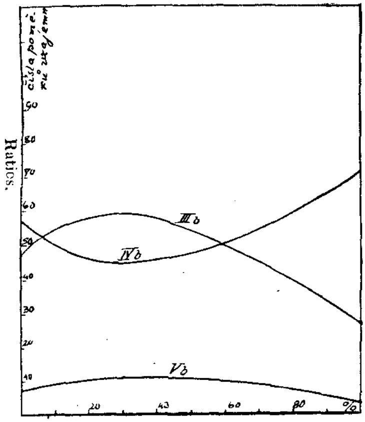


Fig. 3.

Vieth probably kept to his particular proportion for the sake of simplicity, although its accuracy is not the same as the percentage proportion of the components.

Proteins during the melting are divided according to the Vieth's proportion as well as according to two types indicated in the diagram 3, *a* and *b*.

From the diagram we may judge that the division of the protein contents is not even as might be expected. The reason lies probably in the difference of the quality and quantity between casein, lact albumin and lacto-globulin. It would be necessary to make a special study of the division of the proteins in this direction.

There, for the first time, the percentage content of sugar is augmenting towards the end of the melting.

The change of the relative proportion of salt to the other components, according to Vieth, under the same conditions, may be followed in diagram V, *a* and *b*.

The division of sugar contents on similar conditions of freezeing and re-melting may be characterised according to Vieth's proportion with the two types of curved lines of the diagrams 4 *a* and *b*.

Salts divide in a most equal manner, although there are more kinds of salts than

other components.[5] The total quantity is very small (0.70 per cent.), and probably for this reason they do not undergo such considerable changes during freeezing and re-melting.

I also mention two conclusions of my research, (1) the division of the contents of salts approaches more the division of proteins than that of sugar, and (2) towards the end of the fractional re-melting the quantity of salts as well as of proteins diminishes; it is the contrary with the sugar.

During my last unfinished research in Brno, 1928, I obtained the following results, which approach, in some way, the values shown in the diagrams representing the typical division.

In two cases of melting of full fat milk in conical receivers, in the first of which 60 per cent. was frozen and 40 per cent. remained liquid and in the second case the whole was frozen, the results are shown in the following tables, I and II :—

[5] viz., 9 kinds (according to Schrodt and Hansen (CO_2, K_2O, Na_2O, CaO, MgO, Fe_2O_3, P_2O_5, SO_3, and Cl.

TABLE I.

c.c.	Density	Fat	Proteins (Per cent.)	Sugar	Salt	Ratio
2000	1.0300	3.85	3.47	4.95	0.68	38 : 55 : 7
800	0.0322	4.70	3.68	5.62	0.81	36 : 5† : 8
250	1.0731	4.80	7.50	11.23	1.59	37 : 55 : 8
250	1.0417	4.60	4.92	7.10	1.03	39 : 54 : 7
250	1.0165	4.15	1.78	2.34	0.33	40 : 53 : 7
250	1.0018	2.15	0.50	0.69	0.07	40 : 55 : 5
200	0.9985	0.45	0.11	0.28	0.01	27.5 : 70 : 2.5

The first was the original milk. The second was the unfrozen fraction, and the others are re-melted fractions.

TABLE II.

c.c.	Density	Fat	Proteins (Per cent.)	Sugar	Salt	Ratio
1800	1.0333	2.85	3.38	5.11	0.69	37 : 56 : 7
180	1.0775	5.50	7.47	11.59	1.71	36 : 56 : 8
200	1.0723	6.15	7.34	10.99	1.67	37 : 55 : 8
200	1.0584	4.75	6.08	8.73	1.35	38 : 54 : 8
200	1.0424	3.45	4.27	6.26	0.81	38 : 55 : 7
200	1.0262	2.10	2.71	3.08	0.54	37 : 55 : 8
200	1.0135	1.30	1.52	2.31	0.28	37 : 56 : 7
200	1.0059	0.75	0.61	1.08	0.11	34 : 60 : 6
240	1.0044	0.75	0.53	1.08	0.09	31 : 64 : 5
180	0.9989	0.60	0.22	0.53	0.01	29 : 70 : 1

WORLD PRODUCTION OF PLATINUM.

The chief source of platinum, for which the chemical industry must compete with the jewellery trade, continues to be Russia. In 1913 the market price in New York was 44.88 dollars per ounce. By 1924 the price had risen to 119.96 dollars and at the end of 1926 the cost of an ounce was still high (113 dollars). There was a distinct drop in price during 1927 and at the beginning of 1928 an ounce cost only from 60 to 65 dollars. There is now an upward trend again and the present price level is 75 dollars.

The chemical and electrical industries continue to be the largest consumers for the most part in the construction of apparatus, although there has been an increase in the amount taken by industries where platinum preparations are used in catalytic processes.

The following table shows the world's production during the last few years.

	kg.		kg.
1913	8,279	1925	4,155
1923	2,634	1926	4,794
1924	3,208	1927	5,675

Before the war Russia had a virtual monopoly of the metal, but although the bulk of the annual output still comes from the Urals, noteworthy quantities are now extracted in Columbia, Canada and South Africa. From 1914 to 1923 Columbia's supply was the principal source for the United States. Until recently the Canadian supply was insignificant but it has shown considerable annual advances.

RECOMBINATION SPECTRA OF IONS AND ELECTRONS IN CAESIUM AND HELIUM.

By F. L. Mohler and C. Boeckner.

Method. — Thermionic discharges in caesium and helium were operated to give strong continuous bands and spectrophotometer measurements of intensity distribution were made in connection with probe wire measurements of electrical conditions.

Discharge Conditions. — Excitation of these spectra is favoured by high electron and ion concentrations of the order 10^{13} per cc. and low electron speed. Electrons have a Maxwell distribution of average energy between 0.15 and 0.4 volt.

Intensity.—Intensity depends on the ion concentration independent of discharge current and voltage. The increase with ion current is less than the square and nearly the first power at high intensity. Intensity increases rapidly with pressure.

Intensity Distribution.—Measurements of intensity distribution in the $2P$ band of caesium and of electron velocity distribution were made under a variety of discharge conditions. Some measurements on the $3D$ band are given. Photographs and approximate intensity measurements on continuous bands of helium show a strong band beyond 2^3P and fainter bands beyond 2^3S, 2^1P, and 2^1S.

Afterglow.—By means of a sectored disc and commutator the spectrum of the caesium afterglow was photographed. It is characterised by a more rapid decrease in intensity of the continuous bands with decreasing wave length.

Conclusions.—Results on intensity distribution are explained on the basis of simple recombination, although absolute values can not be explained in detail. The relative values of probability of recombination as a function of electron energy are independent of discharge conditions. The form of the functions for the levels $2P$ and $3D$ of caesium are similar. The probability of recombination is proportional to $1/v^2\sqrt{v-v_i}$. This corresponds by the principle of detailed balance to an absorption coefficient beyond the limit proportional to λ^4.

Introduction.

Another paper of the same title describes a type of thermionic discharge in caesium which shows strong continuous spectra extending to the violet from each series limit. The intensity of the continuous bands was enhanced with increased current and vapour pressure in a manner consistent with the hypothesis that the radiation resulted from recombination. The paper included photographs of the spectra in potassium as well as caesium and visual spectrophotometer measurements of the caesium bands.

The present paper describes experiments in which probe wire measurements of electrical conditions in the discharge were made in connection with intensity measurements. It includes measurements in caesium and in helium.

When an electron of velocity v recombines with an ion into an energy level of limiting frequency, ν_i, it will radiate a quantum of frequency ν where

$$h\nu = h\nu_i + \tfrac{1}{2}mv^2 \qquad (1)$$

Thus, the intensity $J(\nu)$ at any frequency greater than ν_i depends on the concentration of electrons of the corresponding speed, $N-(v)$ on the concentration of ions, $N+$, and on a probability factor which is a purely atomic property. The probability can be expressed as the effective collision area times the electron velocity $vq(v\nu_i)$. Equating the quanta emitted and the effective collisions

$$J(\nu)/h\nu \; d\nu = \Sigma N-(v) \,.\, N+ \,.\, vq(v\nu_i)dv \qquad (2)$$

The summation extends over all limits of frequency less than ν, but in practice one level is usually predominant at any one frequency.

Unfortunately ,inherent difficulties in the electrical measurements leave the values of the concentrations uncertain ,so that only relative values of $q(v\nu_i)$ are derived. There is a possibility that under the experimental conditions the random Stark effect of neighbouring ions will seriously alter the values o fthis. A recent theoretical paper on Stark Effect and Series Limits discusses the results obtained in the earlier paper and shows that the limits of separate atoms may be diffused over a range of several hundred angstroms. Paschen has made use of the Stark effect broadening of lines to estimate the ion concentration in helium discharges showing recombination bands.

Apparatus and Procedure.

Discharge Tubes.

Most of the work has been done with a quartz tube with a flat window at one end. A hot wire cathode (either tungsten or oxide coated platinum) was near the axis of a cylindrical anode with the ends closed except for slits for viewing the discharge. The probe was usually a platinum wire 4 to 10 mm. in length and 0.5 mm. in diameter, placed parallel to the axis within a centimetre of the cathode. In a general survey of discharge conditions a variety of probes

have been tried, and in one tube the probe could be moved by an external magnet.

The caesium tubes were sealed off the pumps after outgassing, while in work with helium the gas was either circulated through charcoal in liquid air or at least kept in contact with the charcoal trap during the experiment.

Intensity Measurements.

A method described in the first paper has been adapted to photographic spectrophotometry. A region of the discharge close to the probe was focussed on the plane of the filament of an incandescent lamp ,and this was focussed on the on the slit of the spectrograph. Quartz fluorite achromats were used and the lamp was a quartz tube with flat end plates containing a tungsten hairpin filament. This was calibrated in terms of colour temperature *versus* current by an optical pyrometer. The procedure was to match the filament and discharge visually or by trial and then take a series of exposures, changing the lamp current by convenient steps. The photographs showed the wave lengths at which a match was obtained, and the intensity at these wave lengths could be computed by Wien's law.

In some work the intensity of the caesium $2P$ band was measured by sighting an optical pyrometer with a green glass in the eyepiece directly on the discharge. The glass transmitted a narrow spectrum range near the head of this band.

Electrical Measurements.

The usual method of measuring probe characteristics was used except that because of the rapid variation in current it was necessary to correct the applied potential for the voltage drop across the leads and milliammeter. Voltages were measured relative to the anode.

The theory developed by Mott-Smith and Langmuir has been applied. At negative potentials such that only positive ions reach the probe the current $I+$ is given by the equation

$$I+ = N+ca\sqrt{eV_0+/3\pi M} \qquad (3)$$

where $N+$ is the concentration, $V+_0$ is the the average kinetic energy, and M the mass of the ions; a is the area of the sheath around the wire and changes with the voltage in accord with the space charge equation. On the basis of published tables, a can be evaluated from the value of $I+$ at any applied potential V.

As the negative potential is reduced, electrons reach the probe, and, in general, these fall in several velocity groups, the slowest of these groups heing by far the largest. Assuming that this group has a Maxwell distribution, the current contributed by it is:

$$I- = a_0N-e\sqrt{eV_0/3\pi me^{-3}} \qquad (4)$$

$$\log I_2 - \log I_1 = 3/2 \log e(V_1 - V_2)/V_0 \qquad (5)$$

where $N-$ is the concentration and V_0 is the average energy of the electrons; a_0 is the area of the probe, while V_1, V_2, I_1, I_2 are specific values of V and I. The plot of log I against V is a straight line(if there is a Maxwell distribution, and the slope of this determines V_0. The linear relation ends at $V=o$, and the co-ordinates of this discontinuity give the space potential and N. Note that V_0+ of (3) is not measured and $N+$ is not directly determined.

General Remarks on Discharge Conditions.

The continuous spectra were excited in caesium with currents between 0.1 and 1.5 amps, applied potentials between 2 and 10 volts, and a vapour pressure of 0.05 mm. or more. In helium comparable currents were used at from 20 to 50 volts with a pressure between 2 and 15 mm. Under these conditions the potential drop is concentrated in a thin sheath around the cathode, while a diffuse glow extending toward the anode shows the continouos bands. The region of diffuse glow is characterised by high ion concentration and exeremely low electron speed. Semilog plots of the electron current are linear, which indicates that most of the electrons fall in a single group with a Maxwellian distribution. The average energy is between 0.1 and 0.4 volts. Attempts to extend the current voltage curves through the space potential were generally unsuccessful. Except with extremely small probes the probe current robs the discharge before the space potential is reached. With small probes the currents tend to drift and become unsteady, presumably because of overheating.

Results obtained with larger probes permit accurate determinations of the average electron energy and the positive ion current, and it has seemed advisable to limit our attention to these measurements for the present rather than to sacrifice precision.

The change in positive ion current with voltage was relatively small and could be accounted for by the space charge equation. In some cases a well-defined group of high-speed electrons was detected with a maximum energy of 10 to 15 volts in helium and of 2 to 3 volts in caesium.

In spite of the incomplete data some estimate can be made of the space potential $N+$ and $N-$. In the highly ionised force-free space $N+$ and $N-$ must be nearly equal.

The average energy of the ions, $V+$ will be intermediate between that of the gas atoms and that of the electrons, in an average case between 0.07 and 0.2 volt. This gives an uncertainty of about twofold in the value of $N+$ in equation (3), and $I-$ at the space potential can be computed with the same uncertainty assuming $N- = N+$. The linear semilog plot can be extrapolated to this value of $I-$, and as the electron current doubles in a range of about a tenth of a volt the space potential is determined with an uncertainty of less than 0.2 volt. Measurements with a movable probe in a caesium discharge of 0.3 amp. at 5 volts gave the following results: At 6 mm. from the cathode the average electron energy V_0 was 0.35 volt, and assuming an ion velocity corresponding to 1,000° K., $N+$ was 1.5×10^{13} per cc. The space potential V_s was about +1.3 volts relative to the anode. Close to the anode $V_0 = 0.22$ volt, $N+ = 1.3 \times 10^{11}$ and $V_s = +0.4$. With a discharge of 0.1 amp. at 6 mm. from the cathode, $V_0 = 0.22$ volt, $N+ = 0.4 \times 10^{13}$ and $V_s = +1.0$, while near the anode $V_0 = 0.19$ volt, $N+ = 0.27 \times 10^{11}$ and $V_s = +0.2$. In general, V_0 increases near the cathode and increases as the ion concentration increases. Because of the slightly positive space potential, ions diffuse to the anode as well as to the cathode, while slow electrons are to some extent imprisoned in the space.

INTENSITY AND DISCHARGE CONDITIONS.

Measurements covering a wide range of current and voltage were made by sighting the optical pyrometer, with a green glass in the eyepiece, directly at a caesium discharge. In helium, as in caesium, the variation of intensity is much less than the square of the current and at least at the higher intensities is nearly proportional to the first power.

—*Bureau of Standards, Journal of Research.*

SIR THOMAS HOLLAND THE NEW PRESIDENT OF EDINBURGH UNIVERSITY.

Sir Thomas Holland, who is a Canadian by birth and 61 years of age, has had a distinguished career in this country and in India. He was appointed Professor of Geology and Mineralogy in Manchester University in 1909 and remained there for nine years. He has been Rector of the Imperial College of Science and Technology since 1922. He was President of the Geological Section of the British Association in 1914 and of the Education Section in 1926.

BRITISH SCIENCE GUILD.

DEVELOPMENTS OF BRITISH CHEMICAL MANUFACTURES.

FERTILISERS FROM THE AIR.

Abstract of an address by Sir Frederick Keeble, C.B.E., Sc.D., F.R.S., delivered at Mansion House, London, on April 24.

Science, speaking in the name of Sir William Crookes, predicted some twenty years or so ago, that the world was approaching an inevitable food shortage. The green plant which makes all the food of the world, could not get enough raw materials to do its work sufficiently fast to supply all mankind. Unless then the green plant was speeded up, man must starve. The reason why the green plant did not work fast enough was because the earth failed to supply it with sufficient raw materials. What was chiefly lacking was nitrogen. Without sufficient nitrogen in the form of salts of ammonia or nitrates, the green plant is unable to run its manufacturing process for the production of sugars and proteins at anything like maximum capacity. The green plant has to slow down and mankind in consequence to die down. Lack of available nitrogen has always limited life on this planet.

Now, however, science has falsified its own gloomy predictions by making combined nitrogen plentiful and cheap. In the past the supplies which the green plant used were derived from manure heaps, from the nitrate beds of Chile and from ammonia liquors distilled from coal and fixed as sulphate of ammonia. Now these supplies are every day becoming of less relative importance owing to the almost incredible rapidity with which synthetic nitrogenous fertilisers are being produced from the air.

There is indeed nothing new under the sun and the marvellous ingenious inventions of scientific men which have led to this great new industry find their counterpart in the cunning contrivance of Nature herself whereby some of the simplest micro-organisms of the soil are engaged in making fertilisers from the air. Some of these micro-organisms mak nitrates and some—the so-called nitrogen fixers which occur in land and sea—bring the nitrogen into more elaborate combinations.

But all these natural processes are too slow for the modern world and in the factories at Billingham in this country and in those of Germany, France and elsewhere nitrogen of the air is now being made into fertilisers at the rate of over one million tons per year. Although industrially this is a

vast quantity, looked at cosmically it is a mere bagatelle; for the stores of nitrogen in the atmosphere are so vast and are being so continually replenished that at this rate of usage, Billingham and all other factories could go on doing their best for 4,000 million years without using up the supplies.

Largely in consequence of this rapid production of nitrogen the farmers of the world are acquiring the habit of using more nitrogeneous and other fertilisers. Before the War, in 1913, farmers throughout the world used annually about three-quarters of a million tons of nitrogen in all its various forms. In 1928, the total agricultural consumption amounted to nearly 1½ million tons of nitrogen. Different nations of the world are acquiring the nitrogen habit at different rates. Holland leads the way, followed closely by Belgium. Germany comes next, employing about one-third of the amount per acre used by Holland. The fourth place in the intensive use of nitrogen is occupied by Holland. Egypt comes next and then Great Britain, which uses about little more than half what Germany applies to the acre. France lags behind England and interestingly enough the use of nitrogenous fertilisers in the United States is well below that of Western European countries. We have borrowed so much from the United States that it is pleasant to find that in the nitrogen habit there is something they might well borrow from us.

It is not surprising having regard to the extension of manufacture of nitrogenous fertilisers that the present price is low. Indeed it might be said that the only thing which is cheap in the world to-day is nitrogenous fertilisers. This cheapness provides the farmer with the best means of reducing costs and obtaining improved economic results fro mhis farm; for it has been shown by very full and careful experiments that the use of nitrogenous fertilisers on soils adequately provided with the other substances necessary for production, is the surest of agricultural investments. The application of 1 cwt. of nitrogenous fertiliser to the acre gives an increase of 2½ cwt. per acre of cereals, ond 1 ton of "roots" in the case of potatoes or swedes; and so on for other crops.

The great factory at Billingham which is ensuring that this country shall have an adequate share in this new industry has, like the industry itself, developed at a great pace. Billingham began producing nitrogenous fertilisers in 1924 when its output (of sulphate of ammonia) was 50,000 tons. This was doubled in the following year, had increased five-fold by 1928 and is expected to reach a total of three-quarters of a million tons per annum by 1930. By this date the fertilisers manufactured there will not only contain nitrogen but other plant foods. This work has been rendered possible by the bold forethought of Lord Melchett and his colleagues, by the genius for leadership of Colonel Pollitt, by devoted work on the part of the scientific staff which now numbers more than 150, and by the splendid support which has been given to the directing staff by the 6,000 workers already employed at Billingham—which number it is expected will be more than doubled in two years' time.

The products of Billingham are not handed on to the farmers of the Empire until they have been tested thoroughly at the Agricultural Station of Imperial Chemical Industries at Jealott's Hill, near Maidenhead. When they have proved their worth, the fertilisers are distributed throughout the Empire by the several organisations associated with Imperial Chemical Industries; thus this great industrial concern is lending powerful aid to what is, after all, the first and most essential of all industries —namely, Agriculture.

GENERAL NOTES.

GLASS WARE.

MERCHANDISE MARKS ENQUIRY.

The Standing Committee appointed by the Board of Trade will resume their enquiry as to whether imported glassware (other than lamp-blown glassware and scientific glassware) should bear an indication of origin, at 10.45 on Monday, 27 May.

The enquiry in regard to lamp-blown glassware and scientific glassware will be held at 11.30 a.m. on Monday, 3 June, and at 10.30 a.m. on Tuesday, 4 June.

The enquiries will be held at the Board of Trade Offices, Great George Street, London, S.W.1. Communications should be addressed to the Secretary, Mr. E. W. Reardon, at that address.

COPPER DEPOSITS IN ARCTIC CANADA.

The Financial Post (Toronto) of April 12, contains an interesting article by Janet Munro, describing the "Vast copper belt which covers the area north of the Prairies."

Information is given, culled from historical references, showing that native copper is

found in large quantities in the north country and the opinion is expressed that the copper-bearing area may be even more extensive than the Lake Superior region now producing such a large proportion of the world's copper supply.

In view of the recent completion of the Hudson Bay Railway, and of the development of aerial prospecting and motor tractor transport in the north country, the opening-up of copper mines in Arctic Canada may be considered to be more practicable than it has hitherto seemed.

AERIAL MINERAL EXPLORATION IN NORTHERN CANADA.

The recent annual report of the Northern Aerial Minerals Exploration Company, Ltd., shows that in 1928 no less than 100,000 miles were flown by pilots in the service of that Company. The territory covered extended all over northern Canada from Ungava in northern Quebec to the Yukon Territory on the west.

IMPERIAL CHEMICAL HOUSE ARCHITECT.

Sir Frank Baines, the architect, who carried out the design and construction of Imperial Chemical House, Millbank, was recently entertained to lunch by the directors of the Company. There were present Lord Melchett (chairman), who presided, Sir Harry McGowan (President), the Hon. Henry Mond, Lord Reading, Lord Birkenhead, Sir Max Muspratt, Dr. Clayton, Messrs. Mitchell, Nicholson, Rogers, Wadsworth, Solvay (Directors), Mr. Janssen (of Brussels), Dr. Coates (Treasurer), Mr. Dickens (Secretary), and Major General Duncan (Head of Staff and Establishment Department).

Lord Melchett stated that he was very glad that the occasion provided the opportunity of Mr. A. B. Purvis, of Canadian Industries, Ltd., meeting the other members of the Board. He had met Mr. Purvis in Canada and the company felt assured that in his hands the future of a chemical industry in Canada was safe. Mr. Purvis replied briefly and said that in his great country of Canada, Imperial Chemical Industries had foreseen the great possibilities of development. He was going back to Canada convinced that the courage and vision of those directing Imperial Chemical Industries would enable the awakening spirit of his country to establish itself in practical affairs.

Lord Melchett then said it was his very pleasant duty to present to Sir Frank Baines on behalf of the directors of Imperial Chemical Industries a model of Imperial Chemical House which they desired him to accept as an appreciation of the respect and admiration for the building which he had constructed. He had recollections of the great services which Sir Frank Baines had rendered during the war in the construction of factories designed for producing the requisites necessary for winning the war. Sir Frank Baines had never spared himself in the execution of his duties either in war or peace. When Imperial Chemical Industries determined to build a new head office Sir Frank was the obvious person to whom they turned. The new building was not only an example of beauty but a wonderful example of what British craftsmanship could achieve.

Sir Frank Baines, in his reply, stated that Lord Melchett had always made exceeding demands for rapid completion of work during the war. He had been equally insistent upon achievement on the new building. Mr. Henry Mond, who had been in direct consultation day by day, was largely responsible for the final result. He desired to thank the directors for the charming gift which they had given him.

The presentation consisted of a sterling silver model of Imperial Chemical House, which is described by experts as an excellent example of the art of the silversmith. The model includes all the essential architectural and other features (including carving) of the building, and was executed by the Goldsmiths and Silversmiths Co., Ltd., in record time. It is another example of the craftsmanship of British workers which has been exemplified in sculpture, carving, woodwork, metal-work and design in Imperial Chemical House.

MENTAL DISEASES AND THE PUBLIC.

(From the *African Chemist and Druggist.*)

The slowness which characterises the decline of superstition and the ignorance born of it is notably exemplified in the present day attitude of the public towards mental disease. That mental disease should in the middle ages when belief in sorcery and witchcraft was general, have been associated with demoniacal and angelical agencies is intelligible. In those days when credulity and superstition did service for psychopathology people were satisfied that when a quietly, well-conducted person suddenly became voluble, aggressive and unrestrained, the change was due to operations of an evil spirit that had taken possession of him. And the treatment meted out to these poor

sufferers was likewise suited to this conception and the morals of the age. A few fortunate ones, however, whose mental disorder assumed a different form were treated with consideration amounting almost to reverence.

Public opinion still regards the Mental Hospital as a necessary half-concealed social excrescence and mental disease as a calamitous disgrace affecting not only the sufferer but even the relatives. At the same time it elevates medical and surgical diseases to a place of pride so that to talk freely and even boastfully of one's operations and illnesses is the right thing. There is, however, a complete analogy between physical and mental disorders. Just as none of us is immune to physical disease so none of us is immune to mental disease. As with advancing years our physical health declines so with increasing years our mental faculties fail. The question of liability to mental illness is determined merely by our individual staying powers.

Even in their manifestations there is a certain resemblance between bodily and mental disease. Disease is often merely an abnormal functioning—an exaggerated one as in cancer or exophthalmic goitre, or a diminished one as in dyspepsia or myxoedema. The same holds good for mental disease, so that proliferative growth of cancer represents in the sphere of the body cells what the exuberance of simple mania does in the sphere of emotions. A diminution in emotional functioning is seen in mental stupor. Briefly, in bodily disease we deal with bones, muscles and glands. In mental disease with emotions, will and intellect.

It is a pity that the tendency at one time to have wards for mental patients in general hospitals was not fostered a little more, for the present estrangement between the general and mental hospital would not have been so marked. Again, the fear well grounded enough 150 years ago, that persons can be spirited away illegally into mental hospitals by interested parties has resulted in such markedly restrictive legislation besetting the admission of patients into these institutions that the delay resulting therefrom often means firmer establishment of the disease and lessening the chance of recovery. Of course very often the delay is actuated by misguided relatives wishing to "keep him out of the Asylum as long as possible." However, the regulation whereby a patient can voluntarily seek admission for treatment should overcome many difficulties and is being increasingly made use of. Over 6 per cent. of the patients in the Royal Mental Hospital, Edinburgh, are there as "voluntary boarders."

The very word "Asylum" is a misnomer. As Dr. Lord, Editor of the *Journal of Mental Science* in a recent historical review of mental disease points out, it originally means "a place people seek as a fixed home" or a "place which shelters and cares for those who need shelter and care but does not detain them." Similarly the term lunatic, superstitious in its derivation should long ago have been discarded.

Just as all physical diseases do not require hospital treatment, so all forms of mental illnesses do not require it. Mild states of depression, "Nervous Exhaustion" and "Nervous Breakdown" can be treated privately. The graver forms, however, being often associated with physical sickness and mental symptoms requiring skilled daily supervision, must be treated in a mental institution, which performs the functions of both a general and mental hospital. Nothing which affects the interests of the patient is neglected, even his spiritual needs, and the restraint placed on his liberty, dictated as it is solely by his needs or safety is the minimum.

The belief that mental hospitals function in secrecy is absurd. There must be in the Union nearly 1,500 persons in daily contact with mental patients so that public would receive much information as to what is done in institutions. Of course, apart from the injurious effect it might have upon the patients, one could throw open these institutions to gratify a curious ill-informed public. Relatives and friends, however, subject to the condition of the patient, are always free to visit their sick.

The curiosity with which the insane are regarded may partly be due to the nescience and mystery that in the public mind is still associated with the development of the disorder; ignorance breeds wonder. The public wants to be shown the microbe that causes mental disease. It is to be hoped though, that modern medicopsychological research which has done so much in clearing up the pathology of mental disease will also ultimately reach and convince the public so that the latter will bestow at least the same sympathy upon the mentally as upon the physically ill. We read that in ancient Greece hardly any distinction was made between the two classes and that about 100 B.C. a psychiatrist, Asclepiades, set up practice in Rome.

We have made slow progress.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Papers read on Thursday, May 16 :—

The Validity of Drude's Equation. By T. M. LOWRY.

The squared term which Livens proposes to add to Drude's equation is too small to be detected in measurements of the rotatory dispersion of organic compounds, and is unproved even in the case of quartz. The infra-red term postulated by R. W. Wood, and more recently by C. E. Wood and Nicholas, in transparent organic compounds which exhibit anomalous dispersion, is purely hypothetical, since no case is known in which the infra-red absorption-bands of these compaunds are optically-active. The prediction of Lowry and Austin that the rotatory dispersion of tartaric acid would become simple if it could be converted completely into boro-tartaric acid has been realised by Descamps in the case of the potassium salt.

The Dissociation Constants of Organic Acids. Part I. The Primary Dissociation Constants of Some Alkylmalonic Acids. By A. I. VOGEL.

Conductivity measurements of malonic acid and of seven alkylmalonic acids in aqueous solution over a range of concentration 1×10^{-4} to about 1×10^{-2} M, and of the disodium salts over the range of concentration 2×10^{-4} to $4 \times 10^{-3}M$, have been made. The values of the conductivities at infinite dilution of the disodium salts have been computed by means of the equation $\mu_0 = \mu + bC^n$ (Ferguson and Vogel, *Phil Mag.*, 1925, vi. L, 971) and the ionic conductivities of the neutral malonate ions, λ_x'', evaluated. For the calculation of μ_0 the conductivity at infinite dilution of the acid ionising as a uni-univalent electrolyte, the ionic conductivity of the acid malonate ion, λ_{xh}', was assumed to be 0.5 $\lambda^{x''}$.

Part II.—The Primary Dissociation Constants of Some Cyclic 1 : 1-dicarboxylic Acids.

The conductivities of *cyclo*propane-, *cyclo*butane-, *cyclo*pentane-, and *cyclo*hexane-1 : 1-dicarboxylic acids and of their disodium salts in aqueous solution have been measured over a fairly wide range of concentration.

The Properties of Nicotine and its Derivatives. Part I. Molecular Extinction-Coefficients. By T. M. LOWRY AND W. V. LLOYD.

It is suggested that the aqueous solutions may contain a pseudo-base of the type investigated by Decker in the *iso*quinoline series.

Part II.—Optical Rotatory Power and Rotatory Dispersion.

Nicotine and its isomeride are lævoratory, the dispersion being controlled mainly by a characteristic frequency at about 2500 A. The salts and the methiodides are dextrotatory, the dispersion being controlled by a characteristic frequency at about 1700 A. Since all these compounds show a strong absorption band at about 2650 A., it appears that this band is " optically active " in the former compounds, but inactive in the latter.

Investigations on the Dependence of Rotatory Power on Chemical Constitution. Part XXXIV.—Borotartaric Acid. By S. G. BURGESS AND H. HUNTER.

Boric acid, when added to solutions of tartaric acid, increases the rotatory power and changes the character of the rotatory dispersion of the latter acid. These effects have been ascribed by earlier workers to compound formation, which is assumed to " fix " the tartaric acid in one of its hypothetical labile forms which is supposed to exhibit simple rotatory dispersion. An alternative hypothesis is now advanced which ascribes the phenomena to the formation of an additive compound by means of a semi-polar double bond between the boron atom and one of the oxygen atoms in the tartaric acid molecule. This oxygen atom thereby acquires an asymmetric character in the same manner as does the sulphur atom in the sulphoxides and related compounds described by Phillips and his co-workers. This hypothesis also accounts for the fact that combination of this kind is shown almost exclusively by boric acid, and it also offers an explanation of the marked changes in the acidic behaviour of hydroxy-organic compounds which occur when boric acid is added to their aqueous solutions.

The solubility isotherms in the condensed ternary system, boric acid-*d*-tartaric acid-water have been determined at three temperatures, and a potentiometric investigation of the same system has been carried out. The view that compound formation occurs is upheld, although attempts to isolate the solid compound were unsuccessful. The electrical measurements indicate that solutions of boric and tartaric acid which very closely simulate simple rotatory dispersion in the visible region of the spectrum are not chemically homogeneous in the sense

that nearly all the tartaric acid is combined with boric acid, but that about 40 per cent. of the tartaric acid in the solutions remains uncombined.

ROYAL AGRICULTURAL SOCIETY.

The proceedings at the monthly Council on May 8 included the presentation of the Chemical Committee's Report.

Consideration had been given to a letter from the Ministry of Agriculture with regard to the representation made by the Committee at their last meeting, that the same standard should be exacted for foreign barley as for English barley, and a letter had been read from Dr. Voelcker giving his views on the matter.

The following report had been received from Dr. Voelcker :—

1. *Federal Barley.*—Following on the letter addressed by the Society to the Ministry of Agriculture on this subject, it was ascertained that, as the report of the Government chemist had not yet been received, it had not been possible to take action in the matter of the cases referred to the Ministry with a view to prosecutions following. Shortly after this, however, the reports were received, and were transmitted to the County Council in question for them to decide what steps they would take. The Agricultural Committee of the County Council met, but finding that the reports were not of a sufficiently decided character to ensure the success of a prosecution they decided upon abandoning further proceedings.

This, though dealing with the particular cases referred to in the Council's report of April 10, does not dispose of the general question raised by the Society with the Ministry as to demanding the same standard of purity for foreign barley as it required for home-grown barley.

2. *Screw-pressed Linseed Cake.*—Mouldy and containing much sand.

In this case, reported last month, it has since transpired that the cake has been returned to the vendor, and the purchaser is waiting until his cattle have recovered, after which he intends to make his claim.

3. *Middlings.* — Dirty and adulterated with rice and rice-husk (shudes).

A member resident in Surrey purchased from a well-known local firm some middlings for a sow to which eight young pigs were born on August 8. The sow was fed with middlings and separated milk only. On April 10 one of the young pigs died and a second on April 17. Suspicion having been raised as to the middlings supplied, a sample was sent to me for examination.

This I found to be dirty, having excess of weed seeds and containing also bits of rice and of rice-husk or shudes, the latter a substance of rough and irritating nature, and likely to act prejudicially to young pigs having access to it. The sample gave mineral matter 9.72 per cent., including silica 1.88 per cent., both figures being high for genuine middlings.

4. *Peruvian Guano* (Rich).

From Shropshire was sent me, for analysis, a sample of Peruvian guano which resembled the rich Peruvian guano of the earlier days when this fertiliser was in great request. The analysis showed it to be of very high quality, it giving 23½ per cent. of phosphates with 14.65 per cent. of ammonia. It is seldom that these are met with nowadays.

Reports from the Botanical, Zoological, and other Committees were also presented.

THE OPTICAL SOCIETY.

A meeting was held on Thursday, May 9, at the Imperial College of Science and Technology, South Kensington. Dr. R. S. Clay, Past President, was in the chair. The following paper was read and discussed :—

Contributions to the History of the Spectacle Makers' Company. By T. H. Court and Professor Moritz Von Rohr.

The date of the Charter of the Company is 1629 and the governing body originally consisted of twelve officers, a number which has proved sufficient up to the present time. The authors have had access to the minute books and records of the Company; as, however, the books were burnt in the great fire of 1666, information before that date is very scanty. They have compiled a chronological list of some 452 freemen, with the names of the masters to whom they were bound and of their own apprentices and other information. The list also contains details of 33 of the more important opticians who were not freemen. Many interesting details are given of the contributions, fees and rules of the Company and of the social status of the apprentices. In the first half of the 17th Century, the handicraft consisted of grinding lenses on stationary iron tools and polishing them, probably with tin oxide, and mounting them in horn rims. The principal duty of Master and Wardens was to ensure equality of competition amongst the brethren but they were authorised by their laws to search work shops and penalise bad work by heavy fines. It was unlawful, for

instance, to sell frames or glasses alone and to grind plano-spherical lenses. The first spectacle shop seems to have been opened by John Marshall in 1675. This was an important development and led to an improvement in the status of the spectacle maker who became an optical instrument maker, came into contact with the leading spirits of the Royal Society, became instructed in theoretical optics and mechanics and acquired great skill in his handicraft. A list is given of a number of shop signs and a description of the shop prints or advertisements which are valuable historical documents.

The paper contains a new document relating to the revocation of John Dollond's Patent for achromatic glasses and concludes with a comparison of the history of the Spectacle Makers' Company of Nürnberg with that of London.

There was an interesting display of specimens of optical instruments from Mr. T. H. Court's collection.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Action of Phosphorus Pentachloride on Anisole. With a Note on Detection of o- and p-Chloroanisoles in their Mixture by Converting them into Benzophenone Derivatives. By Mosuke Hayashi.

Occurrence of Trimethylaminooxide in Bodies of Aquatic Animals. By Kiyohisa Yoshimura and Shiro Fujise.

Oxidation of Iodine Ion by Ferric Ion. By Hitoshi Tominaga and Seibi Toraishi.

Viscosity of Ethyl, n-Propyl and Isobutyl Alcohols. By Tokuzo Tonomura and Shinroku Mitsukuri.

Iridium. I. Oxidation-Reduction Potential in the System : Sodium Chloroiridate—Sodium Chloroiridite. By Eiijiro Ogawa.

Vapour Pressure in the Binary System : Water-Methyl Acetate. By Momotaro Suzuyi.

Amino-acid Anhydrides. III Silver Compound of Glycine Anhydride. By Tei-ichi Asahina.

A fund has been opened by Sir James Barr, at Lloyd's Bank, High Street, Putney, S.W., so that Sir Ronald Ross, whose work on malaria has saved countless lives, shall be relieved of all financial anxiety. Sir Ronald, who is 72, has had to draw on capital, including his Nobel Prize, for family necessities.

AN OUTLINE OF THE HISTORY OF MEDICINE IN INDIA.

By Captain P. Johnston-Saint, M.A. (Cantab.), F.R.S. (Edin.).

The Sir George Birdwood Memorial Lecture, *delivered before the Royal Society of Arts, on Friday, May 10. Sir E. Denison Ross, C.I.E., Ph.D., Professor of Persian and Director of the School of Oriental Studies, University of London, presiding.*

By an invitation of the Royal Society of Arts to deliver the Sir George Birdwood Memorial Lecture one cannot but feel an unusual sense of honour in being selected as the Lecturer, more especially as the subject forming the basis of this brief discourse would, I feel sure, have been one of very particular interest to Sir George Birdwood, to whom medical science in India meant so much.

The whole of Sir George Birdwood's career is intimately bound up with the history of medical science in India. It is due to the acumen and skill of a doctor that the British were enabled to obtain concessions in India from which has grown the Indian Empire of to-day.

In 1645, Dr. Gabriel Boughton, surgeon of the *Hopewell*, successfully treated several members of the household of the Emperor Shah Jehan, and in the following year he also treated the Governor of Bengal. For these services Boughton was asked to name his own reward, but he replied that he wished for nothing except that his countrymen might be granted a maritime settlement in Bengal. Shah Jehan granted him a firman which enabled a factory to be opened at Hugli and a settlement at Balasore.

This foundation stone of British power in India was laid, not by fire and the sword, but by that bond of sympathy and understanding which is associated with medicine wherever it is practised.

In those days of course, and for long after, we Europeans held in the lowest esteem every pretention of the East to any real knowledge at all. The many and varied races of immemorial India we thought fit to lump together as "barbarians," and our earliest doctors to go out there wrote, when they wrote at all, of Indian medicine as a matter of childish charms and philtres, almost Voodoo devil dancing. A few inexplicable tricks the natives might have, but in the main their arts were but superstitious nonsense as compared to the blazing light of Western science.

Of the point of view of the Indian doctor faced by this foreign superiority we need now say little; it may suffice to notice that for generations after the first European invasion a malady became known to the Hindu doctor as "Portuguese Disease." It was the contribution of Western enlightenment to the darkness of the benighted East.

Early Western Ignorance of Indian History.

For over two hundred years this ignorance obtained, and as late as Victorian times professedly well informed scholars were writing that Europe owed nothing to India, stressing the point indeed, in at least one case, by referring to the Hindus as "Mongols," an ignorance and indifference which appear extraordinary in a nation which has so close a connection with that vast country. Indian history in fact we practically said began with the English domination and before this was but a farrago of myths and legends.

In 1762 an epidemic of fever was ravaging India and a European doctor notes the death of thirty thousand natives in a single day; this exceptional mortality he explains was due to an eclipse, while other practitioners of his day were writing learned little notes on the effect of the tides of the sea upon the pregnancy of women. Be very sure that all these gentlemen were deservedly severe upon the absurd superstitions of Hindu so-called medicine.

The Causes of our Early Ignorance.

Sanskrit treatises on medicine had been hitherto little noticed by scholars. The subject was not of general interest, and to translate these treatises in any useful manner would necessitate the translator being not only a perfect Sanskrit scholar but a physician as well. Murther, the Hindu himself has a poor sense of history as we understand the word. Art, he says in effect, possesses no Ancient or Modern, and personalities have a poorer place than amongst ourselves.

In the second place our system of education had already given us an apparent beginning for all the arts and sciences. A disproportionate part of our education was devoted to ancient Rome and Greece and in Greek history we came to Hippocrates. Here we had got a founder of medicine all ready for us, and that there might have been any one before him few of us were disposed to inquire.

The third reason is that about the time of the first European introduction to India, medical science in that country had fallen to perhaps the lowest point in the curve in all its long history, and so vast is the scope of this subject that it is only the fringe of it that I dare attempt roughly to trace.

The Dawn of History.

Into the question of the dates of the beginnings of Indian civilisation this is not the place to go, for the truth is that with all our speculation we do not know anything definite. It was only some 120 years ago that we of the West first began to apply ourselves to the study of Sanskrit, and though since then whole libraries have been written upon the problems of Aryan beginnings, we cannot yet be satisfied that we have reached a definite establishment of truth.

Some there are who say that the great Aryan race had its birthplace amid the recesses of Central Asia, others hold on the other hand that it is rather to Scandinavia or North Germany that we should look for its origin.

We used to be satisfied that the oldest Vedas dated back to perhaps 2000 B.C. Whitney, Grassmann and Benfey provisionally assume 2000 B.C. as the starting point of Hindu literature. Brunnhofer has suggested 2800 B.C., Prof. Jacobi of Bonn supposes the period to go back to 4000 B.C., while according to one school it may be that we should date them back to some even more remote glacial age when the very world itself was not the earth we know to-day. The Avesta, they, say, points to an Aryan paradise that can only have been the North Pole, a region removed by tens of centuries from anything of which to-day we can have the least conception.

The Mythology of Medicine in India.

Whether the Rig Veda and the rest date from 1500 B.C. from 2500 B.C., from 4500 B.C., or from some dateless date age even further back still, for present purposes is not our concern. Let us simply take the story as we find it. The philologist studies legends in order to fill the gaps in broken epigraphic compositions; the historian uses them to push back to their sources and to find a base whence he might move forward in search of reality. And so we find then that the Self-create Brahma, having for the guidance of the universe written the Four Vedas, and amongst them the Atharva Veda, communicated them to other gods, the two Aswins or sons of the Sun becoming the particular custodians of the Atharva Veda and thus the medical attendants so to speak of the hierarchy of heaven.

Next came the Upvedas or supplementary hymns designed for the more detailed instruction of mankind, and of these Brahma,

taking compassion on man's sick, degenerate and suffering state, produced the Ayur-Veda which contained a treatise of the science of life.

The hymn itself in its entirety has perished and we know it but by fragments and comments in later Indian literature, but even from this secondhand repute we are assured that for untold ages it was this Ayur-Veda that was regarded as the very foundation stone of Hindu medical science.

Then at some later period, after the dèluge, the Vedas were lost and the plight of mankind became once more a sad and suffering one. Then the gods and demons, in order to recover the lost knowledge for the relief of the sufferings of mankind, having collected plants and herbs of divers kinds, cast them into the sea; they took Mandara the mountain as a churning stick, the god Vishnu, the second of the Hindu triad, assusming the form of a tortoise, became the pivot upon which the stick turned; Srisha the serpent served as a cord and the gods on one side and the demons on the other alternately pulling on the serpent, churned the ocean until the fourteen gems or ratanas, rose from the depths amongst which was Dhanwantari the god's physician and the Vedic father of medicine, with the cup of life-giving draught, Amrita, the beverage of immortality.

As Susruta was the father of Hindu surgery, so Charaka, who also wrote a famous book on the science of physic entitled "Charaka Samhita," was the father of Hindu medicine. Susruta was essentially a surgeon and Charaka a physician and it is from these two teachers that the Hindus obtained their science of surgery and medicine in the years to follow after.

(*To be continued.*)

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, June 26, at 4 p.m.—Annual General Meeting.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

The next Ordinary Meeting of the Society will be held on Wednesday, October 16, 1929, when the Annual Pond Life and General Microscopical Exhibition will be held.

The next meeting of the Biological Section will be held on Wednesday, November 6, 1929.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 19 to September 14, 1929.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Friday, May 31, at 9 p.m.—"The Air Pump: Past and Present." By E. N. da C. Andrade, D.Sc.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

13,864.—Challenor, W. A. P., Crawford, F. A. F., and Imperial Chemical Industries, Ltd. — Chemical processes. May 3.

13,966.—Duckham, A. M., Woodhall-Duckham (190), Ltd.—Producing chemical changes by heating. May 4.

13,857.—Gerley, A.—Manufacture of coal tar products. May 3.

13,858.—Meyl, G. E.—Treating celluloid, etc., acetate. May 3.

13,455.—I. G. Farbenindustrie Akt.-Ges. —Solutions of salts of para dialkylaminoaryl-phosphinous acids. April 30.

Specifications Published.

310,212.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges). — Process for liquefying oxides of nitrogen.

310,438.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of organic compounds containing oxygen.

310,594.—Mitchell, A. E., and Imperial Chemical Industries, Ltd.—Production of salts.

310,623.—Davis, W. G., and Imperial Chemical Industries, Ltd.—Manufacture of higher alcohols.

310,635.—Slade, R. E., and Imperial Chemical Industries, Ltd.—Production of pure ammonium sulphates.

Abstract Published.

307,985.—Hydrochloric Acid. — International Sugar & Alcohol Co., Ltd., 2, Pall Mall East, London.

In preparing hydrochloric acid gas from aqueous hydrochloric acid by heating with calcium chloride, the residue of calcium chloride is subjected to reduced pressure, whereby water is distilled and the temperature is reduced ready for use again. Aqueous hydrochloric acid of 30 per cent. strength is heated with calcium chloride solution containing not more than 40 and preferably 30 parts of water to 100 parts of calcium chloride. Hydrochloric acid gas is evolved and passed through a cooling coil to separate water. The bulk of the acid passes off before a temperature of 130° C. is reached. The temperature is further increased to 165° C. when a dilute aqueous hydrochloric acid distils over. The heating is stopped and the residue subjected to vacuum, when water distils over, and a residue containing 30 parts of water to 100 parts calcium chloride, and at a temperature of about 70° C. is obtained.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

LUMINALETS.

501,110.—Chemical substances prepared for use in medicine and pharmacy.—Bayer Products, Ltd., 31 to 34, Basinghall Street, London, E.C.2. May 8.

LACTOMAG.

501,515.—Chemical substances prepared for use in medicine and pharmacy.—Guxson, Gerrard & Co., Ltd., 26, Fountain Lane, Oldbury, Worcestershire. May 8.

RIVANULE.

500,584.—Chemical substances prepared for use in medicine and pharmacy.—Bayer Products, Ltd., 31 to 34, Basinghall Street, London, E.C.2.

MURCOTINE.

500,531.—Chemical substances used for agricultural and horticultural purposes.—Murphy & Son, Ltd., Wheathampstead House, Wheathampstead, Hertfordshire. May 8.

"CHEMICAL NEWS"—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, "CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

URGENTLY WANTED

TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.

also

No. 3400 Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3607.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES :
Administrative : Central 6521.
Printing Works : Hop 2404.

CONTENTS. PAGE.

Swimming Bath Water ... 338
By A Well-Known Engineer.
The Attractive Forces as Conditioned by Propulsion ... 338
By A. Bowman.
The Relationship Between Crystal Structure and Magnetic Properties in Nickel ... 339
By Dr. G. J. Sizoo.
An Outline of the History of Medicine in India ... 339
By Captain P. Johnston-Saint.
Hyatid Disease in Australia ... 343
By I. Clunies Ross, D.V.Sc.
General Notes ... 347
The Development of Sizing Technique 347
Cadmium in Canada ... 348
Fluorine Monoxide ... 348
International Nickel Company of Canada, Ltd. ... 349
Aluminium Paint on U.S. Cruisers ... 349
Proceedings & Notices of Societies :—
The Physical Society ... 350
Notices of Books ... 350
Forthcoming Events ... 351
New Patents ... 851
New Trade Marks ... 852

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

HOLLAND.

WANTED,
AGENCIES OF FIRST-CLASS BRITISH FIRMS

by Dutch Mercantile Gentleman, just returned from BRITISH INDIA, where he has represented for many years a large German Concern of the Chemical Industry.

Please write to—A. M. H., 267, c/o N. V. RUDOLF MOSSE, AMSTERDAM, HOLLAND.

CHEMICAL ENGINEER WANTED

for a Large Undertaking. Should be over Thirty, under Fifty. Must be thoroughly experienced as DESIGNER and have some experience in operating Chemical Plant, such as Heavy Chemicals, Gas Products, Metallurgical Plants. Good salary.

Write personal details and fully as to training and experience, to "PROCESS," care of Dawsons, 118, Cannon Street, London, E.C.4.

ALEMBIC CLUB REPRINTS of Historical Publications. **No. 19.** Just Published. Crown Octavo. Cloth. Price 2s. 6d. Post Free 2s. 8d. (To U.S., $0.65.)

THE FOUNDATIONS OF THE THEORY OF DILUTE SOLUTIONS. Papers on **Osmotic Pressure,** by **J. H. Van't Hoff,** and on **Electrolytic Dissociation,** by **Svante Arrhenius,** 1887.

Edinburgh : Oliver & Boyd, Tweeddale Court.

London : Gurney & Jackson, 33, Paternoster Row.

SWIMMING BATH WATER.

An Interesting Chemical and Bacteriological Analysis.

By A Well-Known Engineer.

Sterilisation with a measured trace of chlorine gas, combined with other treatment, is now the standard scientific practice for enabling water to be used for many months in swimming baths with absolute safety. Some interesting chemical and bacteriological test figures have just been made available in this connection relating to the Hoxton Baths, Shoreditch (London), representing the water after a summer season's running. This corresponds to about 100,000 bathers having passed through the same water, the baths being closed down in the winter months and used for boxing and other sports.

The installation comprises a first-class bath having a capacity of 140,000 gallons and a second-class of 79,000 gallons, and the whole contents of both baths are circulated respectively through the purification plant at the rate of 23,400 and 13,200 gallons per hour, all the equipment having been supplied by the Paterson Engineering Co., Ltd. In the following order the exact series of operations consists, as usual, of straining, treatment with alumina and soda ash coagulent to separate all the colouring matter, using two sets of chemical injection pumps along with the storage tanks, filtration through five 7 feet diameter sand pressure filters, fitted with compressed air cleaning, aeration to give the sparkling condition of fresh water, also by compressed air, using an electric driven blower, continuous sterilisation with chlorine gas by the " Chloronome " apparatus, using generally about one part of chlorine per two million parts of water, and four calorifiers to maintain the temperature of the water at 72° F. in summer and 78° F. in winter, the circulation being maintained by means of an electric driven centrifugal pump.

As regards the chemical analysis of the water after the season's running, the ammoniacal nitrogen in the first-class bath is 0.0026 parts per 100,000 and in the second-class bath, 0.0040, while the corresponding figures for albuminoid nitrogen are 0.0094 and 0.0140. Also the " nitrous " nitrogen is nil, indicating the absence of organic material, and the " nitric " nitrogen is 0.780 parts per 100,000 in both cases. Further, there is no trace of free chlorine, the chlorides are only 5.10 and 5.80 per 100,000 respectively, while the total CO_2 is 37.0 and 36.0, of which 1.20 and 1.80 are " free " CO_2.

The water is also perfectly clear, equal in colour to average good quality drinking water, neutral in reaction, and without smell, while the total hardness is 24.5°, London town water supply being of course very high in this respect. As regards the bacteriological analysis in both baths, Bacillus Coli Communis and Bacillus Enteritidis Sporogenes are entirely absent in 100 cc. The total number of colonies per cc. capable of growing upon nutrient gelatine at 20° C. in three days is 6 in the case of the first-class bath, and 10 for the second-class bath, whilst in each case two colonies only were grown upon Agar Jelly at 37° C. in one day, so that the water is of a very high degree of chemical and bacterial purity.

THE ATTRACTIVE FORCES AS CONDITIONED BY PROPULSION.

By A. Bowman.

The Le Sage hypothesis of Gravitation conceived a crossing of propulsions in all directions in space; and that bodies, mutually sheltering each other, were driven together in consequence of a deficiency of forces plying between them being so conditioned.

Maxwell saw two objections to the theory; one of which may perhaps have disappeared, in consequence of the sieve-like constitution of matter—the wide spacing of units—which allows of atomic constituents at any depth in any two related masses to be effective for this hypothetical mutual sheltering of each other from propulsions received from space to the same degree as if they were uninvolved with any thickness of matter.

The other objection, that the subsequent reacting of forces between masses would exactly make up the deficit created by mutual sheltering is doubtless correct, coming from so high an authority. Yet it seems rather as if propulsions coming from space to matter are absorbed by oscillating systems, and the surplus energy afterwards radiated uniformly in all directions. If that is so, it will still leave a deficiency of propulsions acting between atoms and masses.

Passing to consideration of chemical affinity, there seems nothing in the forces contained and expressed by atomic systems which are capable of formulating the chemical pull of matter to matter. There are orbital oscillations, created waves, and quanta ejected, of various numerical values. These seem either neutral in the business of

attraction, or in repulsive relation to other *atomicities.* But if, in relation to atomicity so constituted as to powers, an outside drive from space propelling the units of matter together is imaginable, then selective chemical affinity may mean what can get through this barrier of rhythmic repulsions to a comfortable close up; which again would mean atomicities possessing some sort of mathematical agreement of interaction with the otherwise repellant systems.

144, Well Street,
Hackney.

THE RELATIONSHIP BETWEEN CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES IN NICKEL.

By Dr. G. J. Sizoo.

The relation between crystal size and magnetic properties in nickel has been investigated, using samples of commercial nickel (containing manganese) and of pure Mond nickel. The conditions under which recrystallisation of nickel takes place were determined as a preliminary to the magnetic investigation.

It was found that, as in the case of iron, with increasing crystal size there is an increase in coercive force and a decrease in maximum permeability and hysteresis, while remanence remains unaffected. The influence of purity of material on the magnitude of variation in properties produced by difference in crystal size is discussed in the light of the researches of earlier workers and of the present author. In very pure nickel the variations are considerably reduced, as compared with those found in material containing the usual impurities (manganese, copper, etc.), but whether they would entirely disappear in material of absolute purity is at present uncertain. The author considers it probable that crystal size and magnetic properties are related to some extent even in the purest material.

(Abstracted from *Zeitschrift für Physik*, 1929, LIII, 449-457.)

MELLON INSTITUTE OF INDUSTRIAL RESEARCH.

The Second Annual Supplement of the Mellon Institute Bibliographic Bulletin has just appeared. This publication lists 1 book, 14 bulletins, 15 research reports, 104 other scientific and technical papers, and 25 United States patents which were published during the calendar year 1928. Copies will be sent to any chemist, librarian or teacher who asks for them.

AN OUTLINE OF THE HISTORY OF MEDICINE IN INDIA.

By Captain P. Johnston-Saint, M.A. (Cantab.), F.R.S. (Edin.).

The Sir George Birdwood Memorial Lecture, *delivered before the Royal Society of Arts, on Friday, May 10. Sir E. Denison Ross, C.I.E., Ph.D., Professor of Persian and Director of the School of Oriental Studies, University of London, presiding.*

(*Continued from page 335.*)

Divisions of the Ayur-Veda.

The Ayur-Veda itself as we know it from its commentators seems to have been divided into eight parts, two treating of surgery, five of some branch or other of medicine and one of what was in later ages generally known as the Elixir of Life. The first dealt with the surgery of the removal of foreign bodies, of healing knife wounds, of bandages, blisters, and the proper treatment of inflammations and abscesses.

The second surgical chapter is concerned with the external organic affections of eyes, ears, mouth and nose. The third chapter, or the first medical section has to do with diseases affecting the whole body, such as fevers and the like.

The fourth chapter is on ailments of the mind; the fifth has to do with the care of infants; the sixth with the administration of antidotes, the seventh with the medicines for restoring youth, and the eighth deals with how the increase of the human race could best be promoted.

"Chemistry" it is true may have been an Arabic word, but the science itself appears in India long before the time of the Arab scholars, for the seventh chapter of the Ayur-Veda treats exhaustively of this science.

Susruta.

Susruta was the son of Vishvamitra, a contemporary of Rama. Precisely when he may have lived we do not know; Sir William Jones places the subjugation of India by Rama about the year 2000 B.C. On the other hand some philosophic scholars assert Susruta to be a contemporary of the Buddha. In the tenth book of the Atharva-Veda there is a hymn on the creation of man in which the skeleton is described according to Atreya and Susruta. This would appear to warrant the assumption that Susruta could not have flourished later than 1000 B.C.

Under his "code," to use a convenient even though not altogether accurate term, the eight books of the Ayur-Veda fall under *six main headings*. It is the two surgical chapters of the Vedas with which he chiefly deals, though as is common even to-day the surgeon also treats to some extent of medical ailments. The first of the six chapters is all surgery proper, but includes observations on climate and on food as affecting health. The second chapter deals with ailments brought about by vitiated humours; his third we might *roughly translate* as anatomy, his fourth as therapeutics, his fifth as toxicology and his sixth and last is supplementary, dealing with various local diseases.

It is, however, surgery in which Susruta specialises, calling it "the first and best of the medical sciences, less liable than any other to the fallacy of conjectural and inferential practice, pure in itself, the worthy product of heaven and certain source of fame." The irreverent layman would seem here to see the distinct foreruuner of western theories.

Charaka.

Very much the same considerations are to be drawn from the study of Charaka. His "code" is arranged in the form of dialogues between the master and pupil, the subjects with a certain lack of system apparently suggesting themselves as they went along. A certain amount of the conversation is necessarily desultory, but its obvious object is the discussion of the subjects most pertinent to the benefit of mankind.

The first book deals with the origin of medicine and the duty of the physician, and here we can trace some sort of analogy to the oath of Hippocrates. The arrangements, properties and uses of medicine are each discussed and the cause, nature and prevention and cure of diseases. Diet, steam baths, the broad classification of foods—these are only a few of the subjects treated in this first book.

The second book describes fevers, tumours, leprosy, mania and epilepsy. The third book considers the nature of epidemics, the peculiarity of the fluids of the body and other subjects. The fourth treats of conception, the variety of the species, the parts of the body and the connection between body and soul. The fifth book is a description of the organs of the senses, their peculiarities and ailments, affections of the speech, causes of diseases of organs, sudden losses of strength and death. The sixth book treats of the means of securing increased vigour and enjoying long life, and different classes of ailments are dealt with, as dropsy, jaundice, asthma, erysipelas, thirst and poisoning; inflammations, the effects of intoxication, abscesses, rheumatism and paralysis, too, all find a place in this book.

The seventh treats of emetics and purgatives, and in its twelve chapters we see a remarkable number of such materia as were known to the ancient Hindus.

The last book, also in twelve chapters, deals with evacuating medicines for fevers, injections for various purposes, clysters and so forth. The arrangement to our modern ideas is often obscure, but that the sequence follows a system there is no possible doubt. With what we might call pure medicine is mixed up a good deal of mythology, and this, too, helps to accentuate a certain lack of scientific system.

Instrumental Surgery.

From Susruta and Charaka sprang many schools and sages. Dr. Wise, of the Bengal Medical Service, writing in 1845, mentions two systems of Hindu surgery, nine systems of medicine, three of materia medica, one of nosology, one on pharmacy, three on metallic preparations. Of this formidable number at least four have left no recoverable trace, but from the others we can gather the strength of the scientific knowledge of the early India.

The instrumental part of surgical treatment, they said, was divided into eight branches, cutting or incising, division or excision, drawing lines which corresponded to what we call scarification, and inoculation, puncturing, probing and sounding, the extraction of solids, the extraction of fluids and venesection and lastly suturing.

For these diverse purposes the surgical instruments were divided into two classes, the Yantras or blunt instruments, and Sastras or sharp instruments. The Yantras which constitute the greater portion of the surgeon's outfit consisted of instruments such as forceps, specula, syringes, cupping appliances, probes, spoons, cauteries, etc. The Sastras consisted of knives of divers sorts for various purposes, needles, scissors and sharp probes. With these Yantras and Sastras went such appliances as thread, leaves, bandages, pledgets ,and a variety of astringents and emollient applications; and these Yantras and Sastras were divided into no less than 125 separate classes.

Hindu Anatomy.

The early Hindu surgeons must have possessed a very considerable knowledge of

anatomy, and we find ourselves faced then with some difficulty in reconciling this deduction with the horror of modern India at even the touch of a corpse. When in 1836 English surgery was first introduced into India, only ten students could be found in the whole of the peninsula even to consider the prospect of dissection, and then on dry bones and on the skeletons of goats; the human body was taboo and it was not till Modoosoodna Gupta managed to lead the way by conquering his prejudices that any progress at all was possible.

The systems of anatomy fall roughly into three schools, those of Atreya who is reputed to have lived about B.C. 1200, of Susruta and of Vagbata who flourished about the second century B.C. While whole books could be written on the various versions that are extant, we need only refer to the pains taken in their catalogues of the parts of the human body. A traditional recension of the statement of Charaka for instance begins as follows. " The body consists of the following parts : the two arms, the two legs, the head and neck, and the trunk. These made up the sexipartite body; inclusive of the teeth and nails it has 360 bones," which are then given on detail. It will be observed that Charaka looks upon the head and neck as being together but one main division.

In Susruta's table on the other hand we get a grand total of only 300 bones as he says " Surgical science knows only of 300 bones. Of these there are 106 in the extremities, 128 in the pelvic cavity, sides, back, shoulder and breast, and from the neck upwards 66. In this wise the total of the 300 bones is made up." And then he proceeds to count them in elaborate detail.

The difference between that of Susruta and Charaka is probably accouuted for by the fact that Charaka counted the thirty-two teeth and the twenty nails as separate bones. But, however, these doctors may have differed as to their way of reckoning, there is no room for possible doubt that their system gave them a very thorough knowledge of anatomy, as indeed must have been necessary for the performance of the operations which we know were freely undertaken, some of them of the utmost delicacy. For not only were limbs amputated, but abdominal sections were performed, fractures were set, ruptures were reduced and foreign substances were dexterously extracted.

To Susruta is due the glory of the discovery of cataract-couching, centuries before it was known to the west, while the plastic surgery of skin grafting and rhinoplasty, only comparatively lately rediscovered in Europe, were frequently practised by the same great Hindu.

His rules lay down exact regulations for the operating room; it was to be fumigated with such and such disinfectant vapours, a light refreshment was to be offered to the patient before certain operations, while before other operations he was to be fasting. The surgeon should keep his hair and beard short, his nails clean and close cut—a doctrine which has been rediscovered by our modern bacteriologists—and wear a clean, sweet-smelling dress. Even anæsthetics in some form or other were known, and at some later period we see in the Bhojaprabandha, a treatise written about 980 A.D., a reference to an inhalation before operation of an anæsthetic called Sammohini recorded to have been used in the time of Buddha.

The Decline of Hindu Surgery.

Hindu medicine reached its golden age at the commencement of the Buddhist period. Hoernle in his " Studies of the Medicine of Ancient India," says : " According to the Indian tradition preserved in the Buddhist Játakas or Folklore, there existed in India in the age of Buddha two great universities or seats of learning in which ' all sciences ' including medicine were taught by ' professors of world wide renown.' These two universities were Kâsî or Benares in the east and the still more famous Takshasilâ or Taxila on the Jhelum in the west."

Jivaka the famous physician who was contemporaneous with Buddha is stated to have studied medicine in the Taxila university. Owing, however, to various causes this golden age of Indian surgery was destined, like other golden ages, to fade away into silver and even baser metals. The ceremonial prejudice against the touching of a corpse rapidly increased, and before long it was impossible for the student to learn his anatomy from practical first-hand dissection. Bodies had to be paid out in water there to be rotten away till at last the skeleton was exposed. In this way only was it lawful to get at the bones. Dissection had to be made on goats, on anything rather than the human body. Anatomy then was being lost as a first hand knowledge. The surgeon under the Hinduism of what we might call the Indian Middle Ages was becoming a person unclean. In the Manu-perhaps from Unupa to Jungala or vice

samhita, the author forbids his readers to eat cooked rice from the hands of a doctor, by which he means a surgeon.

Again with no actual general anæsthetic (for it is probable that the inhalation I have just mentioned referred rather to some sort of doping into comparative insensibiity), the patient was naturally averse to an operation if it could possibly be avoided, and so we begin to find various substitutes for the knife. Incisions were made by caustics and all sorts of cauteries and poultices were in use to avoid actual cutting; and as they avoided surgery so also they shrank from post-mortem examination and thus lost the last opportunity of testing diagnosis. The tide had begun to turn.

Knowledge of the Ancients.

We find then that gravitation was known to the Hindus long before the birth of Newton and that the system of the circulation of the blood was discovered by them centuries before Harvey was heard of. That Harita in tbe Harita Samhita, in a description of anæmia, observes that the disease is caused by clay obstructing the lumen of veins and so clogging the circulation of the blood. The atomic theory again was preached in India centuries before the birth of Christ, and their knowledge and comprehension of the sciences of mathematics and astronomy were remarkable.

With amputation came artificial limbs and in the Rig Veda we have such a reference. An artificial leg, we learn, was made of iron; there were, too, artificial eyes. Rhinoplastic surgery I have already touched upon, and according to Dr. Hirschberg of Berlin, "The old plastic surgery in Europe had taken its new flight when these cunning devices of Indian workmen became known to us." The transplanting of sensible skin flaps is also an entirely Indian method.

In particular the Hindu surgeons were adepts at the forming of new ears and noses from the grafting of flaps of skin. The cause of much of their practice is an oddity that we might notice in passing, the cutting off of nose or ears being a common punishment for the criminal and for the unfaithful wife.

From the Mohavagga we may learn that Jivaka the physician of Buddha practised cranial surgery with success, and long before the birth of Jenner the cow-herds of India were practising a kind of inoculation or vaccination for small-pox. Collecting the dry scabs of the pustles they placed a little of these upon their fore-arm, then puncturing the skin with a needle, so securing a certain immunity. According to at least one scholar, a Dr.Huillet of Pondicherry, actual vaccination itself was known to tne Hindu surgeons. So much then on the side of surgery.

The Hindu physicians were the first to devote their attention to the study of diseases and their treatment, and in medicine their learning in many cases far antedated our own, as was only natural from the immense study given to the properties of every product of the soil. The smoking of datura for example in cases of asthma we owe entirely to India, as also the prescription of nux vomica in paralysis and dyspepsia, and very largely the use of croton. Even the effects of excessive smoking come under the notice of the Indian physician.

In toxicology they had extraordinary skill and in the story of the invasion of India by Alexander, while all the Greek physicians were powerless in cases of snake bite the Indian doctors readily cured those who fell under this affliction. For this reason Nearchus says "Alexander collected round himself the most prominent of the Hindu doctors and proclaimed that any soldier bitten by a serpent was instantly to repair to the royal pavilion for treatment." Their number of antidotes for different classes of case was extraordinary as might be expected from a science one of wbose masters, Charaka, described in his teachings no less than 600 separate purgatives.

In the field of what today we should call Psycho-Therapy the Hindus again held pride of place, and centuries before Freud was heard of, the Hindu doctors were anxiously probing into the secrets of dreams. With much that we were taught to regard till quite recently as absurd, their teachings show signs of a good deal of our newest learning, and in for example the theories of the Terror Dream they came at least remarkably near our 20th century doctrine of the subconscious mind.

Medical hygiene occupied an enormous proportion of early Hindu practice, and the science of climatology at once so old and yet to-day so young was widely practised and understood. There were three distinct sorts of country, Anupa, the moist and marshy districts where "Phlegmatic" diseases and "affections of the wind" would be prevalent; Jangala, the over-dry country where ailments of the "bile and blood" would be common and Mishra, neither too moist nor too dry, too warm nor too cold. Patients suffering from various ailments would be directed to try a different country,

versa, and Mishra would be recommended generally for the period of convalescence.

The codes laid down precise recommendations for the habits of patients of different types, the foods to be eaten, the clothes to be worn, even the hours for sleeping and for getting up. There was no province of human life, however intimate, for which recommendations were not to be found in the ancient Hindu medical code. What we know to-day as Preventive Medicine had its origins in India many centuries back.

(*To be continued.*)

METALURGISTS' CONGRESS IN GERMANY.

A large attendance is promised at the forthcoming German Meeting of the Institute of Metals. To be held in Düsseldorf on September 9-12, this will be not only the first meeting of the Institute to take place in Germany, but will also constitute the first gathering of metallurgists and engineers to be held in Germany since 1914. The Conference is being held by invitation of the Verein Deutscher Ingenieure and of the Deutsche Gesellschaft für Metallkunde. In addition to the presentation and discussion of papers by members of many nationalities —nearly every country in Europe will be represented at the meeting—there will take place visits to works as well as gatherings of a social character. Though participation in the Meeting will be limited to Members of the Institute, non-Members desirous of taking part can be elected—provided that their qualifications are satisfactory—in time to take part in all the proceedings at Düsseldorf, if their applications are received not later than 4 July by the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

PATENTS COMMITTEE.

Board of Trade Announcement.

The President of the Board of Trade has appointed the following committee to report whether any, and if so what, amendments in the Patents and Designs Acts, or changes in the practice of the Patent Office, are desirable.

The Right Hon. Sir Charles H. Sargant (chairman), Mr. Horatio Ballantyne, Mr. H. A. Gill, Mr. E. H. Hodgson, C.B., O.B.E., Sir Herbert Jackson, K.B.E., F.R.S., Mr. W. S. Jarratt, Mr. Fearnley Owen, Mr. J. G. Weir, C.M.G., C.B.E., and Mr. James Whitehead, K.C., with Mr. R. W. Luce, Patent Office, 25, Southampton Buildings, Chancery Lane, W.C.2, as Secretary.

HYDATID DISEASE IN AUSTRALIA.

By I. Clunies Ross, D.V.Sc.

(*Council of Scientific and Industrial Research Bulletin.*)

Introduction.

Over seventy years have elapsed since von Siebold (*1853*) first determined the genetic relationship between the hydatid cyst and the adult tapeworm, *Echinococcus granulosus* (Batsch 1786) Rudolphi 1805 in the dog and thus paved the way for the control of hydatid disease of man and animals. It might well be thought, after the lapse of so many years, and with the growth of what should be, in these days of the wide dissemination of knowledge, an enlightened public opinion, that the information so gained would long have been availed of and that hydatid disease would be now no more than a memory of the days before modern science made possible the control of such parasitic diseases. In Australia, where we pride ourselves on the possession of high general standards of intelligence, education and hygiene, the fact that such a disease, spread as it is in practically every case through the agency of the domestic dog, should still rank as a serious affection of man, appears well-night inexplicable, more especially since the measures necessary for its control are apparently so clearly defined. That hydatid disease still is of great importance in Australia must be admitted after any consideration of the vital statistics of the several Australian States ,since some hundreds of the population are afflicted annually by this dread disease, while of lesser importance, but still of appreciable economic value, are the harmful effects occasioned by hydatid infestation in livestock of which one aspect is seen daily in the destruction of infested organs of animals slaughtered for food. Australia is not alone in the continued incidence of the disease, since concern at its great importance in France was expressed at a meeting of the Society of Comparative Pathology in 1922, while Poppe and Thielkow (1926) have drawn attention to the fact that in Mecklenburg, cases in man and animals have recently shown an increase.

In the following consideration of the incidence of the disease in Australia, it is hoped to show to what extent failure to control the disease in Australia depends on factors hitherto unappreciated or to the neglect to utilise effectively that knowledge we already possess.

OBSERVATIONS ON THE MORPHOLOGY AND BINOMICS OF *Echinococcus Granulosus* (BATSCH 1786) RUDOLPHI 1805.

The Value of the Hooks and Eggs in the Specific Determination of Echinococcus Granulosus.

(*i*) *The hooks.*—Until recent years, generally only two species of *Echinococcus granulosus* have been recognised, the type species *E. granulosus* and *E. oligarthus* first described by Diesing (1863) from *Felis concolor.* In 1924, Brumpt and Joyeux considered a hydatid cyst from an Agouti (*Dasyprocta agouti*) in Brazil to represent a third species which they named *E. cruzi.* Cameron, in 1926, in a general review of the genus *Echinococcus*, considered that *E. cruzi* was not a valid species since the variations between it and *E. oligarthus* could be explained by the immaturity of the scolices of *E. cruzi,* Leuckart (1863) and others having drawn attention to the fact that the mature and immature hooks of *E. granulosus* may differ markedly in size and shape. evertheless, after examining material from the Cape hunting dog (*Lycaon capensis*) and from *Canis lupus* from Macedonia, Cameron found it necessary to create tentatively two new species which he named respectively *E. longimanubrius* and *E. minimum.* Owing to scantiness of material and indifferent preservation the determination of these species was based solely on the size and shape of the hooks.

In view of the interesting possibility thus suggested that more than one species of *Echinococcus* may occur in canines, it is necessary to determine the specific value of the hooks as differential features, and in the light of this to ascertain whether there is evidence that more than one species occurs in dogs in Australia. A large amount of *Echinococcus* material from New South Wales was therefore examined, all of which came from the domestic dog, being collected during the survey of the incidence of hyatid infestation made by Ross (1925, 1926).

STATISTICAL EVIDENCE OF THE INCIDENCE IN MAN.

In discussing the incidence of hydatid disease in man, it is not proposed to compare its incidence in different parts of Australia, but rather to show how far we are justified in considering that it still ranks as a serious disease of man, and to determine by comparison with its incidence in past years how far measures designed for the control of the disease have failed. Ross (1925, 1926), dealing with the incidence in New South Wales, showed that while the ratio of cases of hydatid disease to total admissions to hospitals had fallen very greatly when compared with 1907, the earliest year for which figures for the whole State were obtainable, the total number of cases of hydatid disease showed relatively little decrease; indeed, in 1923-1924, there were more cases of the disease in New South Wales than in any year since 1915. At the same time, it appeared that in certain country districts in New South Wales, which, on the data available, were likely to be centres where hydatid disease was most prevalent, there were indications that cases in man tended to increase rather than decrease. It is possible that such apparent increase in specific country districts may be attributable to the increased amount of surgical work now being undertaken at local hospitals.

Since then, the records of the Dubbo District Hospital have been examined for the past twenty-one years, and as a result the previous indications tend to be confirmed. The cases for each quinquennial period for this hospital were as follow :—1906-1910, 11 cases; 1911-1915, 3 cases; 1916-1920, 7 cases; 1921-1925, 9 cases.

To determine whether these indications were purely of local importance or applied to Australia as a whole, statistics for South Australia were obtained. This State, at least so far as its South-Eastern corner was concerned, had been shown by Thomas (1882-3) to be one of the worst centres of hydatid disease in the world, but little evidence is available as to the incidence in recent years. From the records of the Adelaide Hospital, it was possible to obtain statistics from 1880 onwards. It was found that, though there has been a steady fall in the ratio of hydatid cases to total admissions from 1 in 59 for 1885-1889, to 1 in 421 for 1915-1919, for the last five-yearly period, 1920-1924, the ratio increased slightly to 1 in 419. In addition, the number of cases for the last quinquennial period was 68, compared with 58 and 60 for the two preceding periods respectively. Further, during 1923, Cleland, De Crespigny and Cudmore reported that in over two per cent. of autopsies at the Adelaide Hospital lesions of hydatid disease were present.

In order to determine whether the suggested increase in the number of cases of hydatid disease in Adelaide was supported by figures for the whole State, the number of cases of hydatid disease in the whole of South Australia was obtained for the fifteen years 1911-1925, from the Statistical Register. As a result it was found that though

the ratio of hydatid cases to all cases had fallen from 1 in 471 for the quinquennial period 1911-1915, to 1 in 635 for 1921-1925-26, the number of cases of the disease had increased from 107 in the former period to 152 in the latter. In addition, the cases for the individual years 1921-22 and 1925-26 were 35 and 34 respectively, both of these being greater than in any one year since 1909.

It has been shown by Ross (1926) that during recent years the risk to city dwellers of contracting hydatid disease has decreased very greatly in such cities as Sydney, Melbourne and Adelaide, as a result of the centralisation of all metropolitan slaughtering at abattoirs, and the introduction of improved methods of meat inspection. As a result, a very much greater proportion of cases of hydatid disease now comes from the country than was formerly the case, and this factor must be taken into account in estimating whether there has been any decrease in the incidence of the disease in country districts. When we consider therefore that since 1911 the rural population of Adelaide has increased by only 11 per cent., while the number of cases of hydatid disease has increased by 42 per cent., it is very evident that the disease was more common amongst the rural population for the last quinquennial period under consideration than it was for the previous two quinquennial periods. These facts are even more disquieting than those obtained in New South Wales.

In regard to the incidence of the disease in Western Australia, it was possible, through the courtesy of the Superintendent of the Perth Hospital, to obtain details of the cases treated at this hospital from 1915-1926. For the period 1915-16/1919-20 there were nine cases, while in the period 1920-21/1925-26 there were 35. In addition, the ratio of cases of the disease to total cases was three times as great during 1923-24 as during 1915-16, being slightly over 1 in 500 in the former year and 1 in 1,896 in the latter. It must he remembered, however, that Cleland, in 1908, found a very irregular incidence of the disease in Western Australia during the early years of the present century, but neverthëles such a marked increase as that shown during the past five years can only be regarded as most disquieting.

The statistics given above from two States besides New South Wales definitely support our previously expressed opinion that, despite the general optimism that hydatid disease is of steadily diminishing importance, there is grave danger that unless energetic measures are again directed towards its control, a serious recrudescence of the disease will occur.

Sex Incidence.—The incidence of hydatid diseases among the sexes shows considerable variation in different countries. Thus Cranwell (1908) in the Argentine found a very slight preponderance of males of 490 to 480 females. On the other hand, Finsen (1869) in Iceland, found 184 females to 84 males, and Einarrson (1925) in the same country found that cases amongst females were still more common, though the disproportion was now much less. Dikoff (1925), in Bulgaria, found more cases amongst males than females. In Australia, Thomas (1882) of 870 cases found 493 males and 377 females. Of 920 cases recently investigated by the writer in Australia 529 were men and 391 women.

It is not suggested that sex has any influence in conferring susceptibility or immunity, the disproportion being accounted for by the local conditions which more frequently expose one or other sex to risk of infestation through contaminating the hands from the soiled wool of sheep, and Dévé (1923) suggests that the same factor operates in Tunis.

Age Incidence.—Owing to the slow rate of hydatid cysts, the age at which cysts become clinically important does not necessarily give any reliable indication of the age at which infestation takes place. Nevertheless, statistics relating to children and young adults are of importance from an epidemiological stand-point. Cranwell (1904) found that, in the Argentine, 36 per cent. of cases occurred in children or young adults under 21, while the greatest number of cases for any decennial period occurred at from 21-30 years of age, representing 28.1 per cent. of total cases. Brun and Lauriol (1922), cited by Dévé, found that 15.8 per cent. of cases occurred during the first twenty years of life.

In Australia, in 241 cases in which the age incidence was investigated, 19.1 per cent. of patients were under 21, while the greatest number of cases in any decennium occurred between the 41-50 years, representing 24 per cent. of the total, while 21 per cent. occurred between 21-30 years, and 8.3 per cent. in children under eleven.

Incidence of Liver and Lung Hydatids of Man.—Vegas and Cranwell (1901) found the ratio of liver to lung cases to be 9 : 1, while the authorities cited by Verdun (1913) state

that liver infestations outnumber those in the lung by from 6 : 1 to 9 : 1. In Australian cases examined the disproportion was very much less, being 3.1 : 1. It is possible that improved methods of diagnosis and surgical technique have resulted in the more frequent detection of lung infestations in recent years.

SUMMARY.

1. The value of the hooks in the specific determination of *Echinococcus granulosus* must be interpreted in the light of considerable variation in size and shape found within the species. The eggs cannot be differentiated with accuracy from those of related species of *Tæniæ*.

2. The eggs of *E. granulosus* have been found to be viable under moist conditions at summer temperature for three weeks, but they will not withstand desiccation by direct sunlight for this period.

3. Hatching of cestode eggs appears to occur normally in the small intestine, but it probably occurs under certain circumstances in the stomach.

4. Hydatid cysts may remain viable after removal from the host for four days at temperatures of from 20-23° C., and for thirteen days at temperatures between 4-8° C.

5. Adult *Echinococcus* normally require about seven weeks for complete development, the minimum period taken being 47 days and the maximum 51.

6. Tests of the action of ocriflavine, trypan blue, emetine and tartar emetic on hydatid scolices *in vivo* do not appear to suggest the employment of these drugs in the treatment of hydatid disease.

7. Statistical evidence shows that the incidence of hydatid disease in man in certain Australian States no longer shows any steady decrease, while in South Australia there appears to be definite evidence that the incidence of the disease is increasing.

8. A very high incidence of hydatid disease is shown in cattle and sheep in certain areas in New South Wales.

9. A very high incidence of the adult worm in the dog has been found in country districts, two classes of dogs, namely, those at slaughter yards and on sheep stations, being most heavily infested. It is considered that infestation of the dingo and fox occurs naturally, but infestation of the cat only very rarely.

10. It is considered that the most important factor in producing infestation of the dog in Australia is the large sheep population, and the widespread habit of feeding raw viscera of these animals to the dog. It is not thought that cattle, pigs or rabbits are comparable in importance to the sheep as a source of infestation.

11. Infestation of man is most frequently caused by the careless handling of infested country dogs, this being largely due to the widespread ignorance of the true nature of hydatid disease and its method of spread.

12. Flies have been found capable of ingesting *Echinococcus* eggs, and are thought to be possible carriers of infestation to man.

13. Infestation through drinking water or by the ingestion of raw vegetables is not thought to be of as great importance in Australia as was previously supposed.

14. It is considered that the most important control measure to prevent infestation of the dog, consisting of the boiling of all offal of cattle, sheep and pigs before feeding to dogs, must be put into practice by private individuals.

15. Infestation of man may be prevented by the observance of certain elementary rules of hygiene, especially that of always washing after handling any country dogs, and never allowing young children to play with or handle dogs.

16. Dogs should be treated periodically to free them from the adult worm, critical tests of arecoline hydrobromide showing it to have a very high degree of efficacy for this purpose.

17. An educational campaign must be carried out in order to instruct stockowners and others of the nature of hydatid disease, how it is spread and how it may be avoided. It is considered that teaching should be given in all country schools, and that coloured posters graphically depicting the dangers of hydatid disease should be placed in schools and slaughter yards.

18. Legislative action should be taken to secure the establishment of abattoirs at all country towns of over 2,000 inhabitants with the consequent abolition of slaughter yards.

19. Amendments to the regulations governing country slaughtering should include hydatid disease as a disease under the Act, and should place the onus of detection and destruction of hydatid lesions on the slaughterman. Receptacles should be placed in all slaughter houses for the reception of all diseased meat until it can be destroyed.

20. Amendments in regard to the regulations governing meat inspection at abattoirs are suggested to ensure the examination of all sheep viscera by qualified inspectors, and the efficient disposal of all meat showing hydatid lesions.

GENERAL NOTES.

CANADA'S TRADE WITH THE UNITED KINGDOM.

The Dominion Bureau of Statistics, Ottawa, reports that during March last imports for consumption from, and Canadian exports to, the United Kingdom were valued at 17,400,070 dollars and 20,365,865 dollars, while during the twelve months ended 31 March last the totals were 194,020,593 dollars and 429,730,485 dollars, respectively.

PROGRESS IN CANADA'S CHEMICAL INDUSTRIES.

The Dominion Bureau of Statistics at Ottawa has forwarded to the High Commissioner of Canada in London its final report on the Manufacture of Chemicals and Allied Products in Canada during the calendar year 1927.

Increased outputs and a slightly downward trend in prices are features of the 1927 statistics, the growing importance of the chemical industries in Canada being reflected in the gain shown in the apparent consumption of these products. In 1927, the consumption of chemical products is estimated to have reached a total value of nearly $143,000,000, or more than $5,000,000 in excess of the 1926 total. The eport contains a general review of the industry dealing with capitalisation, employment, power equipment, production, imports and exports, and there are eleven chapters in which statistics of particular branches of the industry are shown, followed by a directory of manufacturers in each section. The report in question may be consulted at the office of the High Commissioner, The Canadian Building, Trafalgar Square, London, S.W.1.

POTATO STARCH FACTORIES IN NEW BUNSWICK.

The Provincial Government is encouraging the erection and operation of starch factories in the potato growing sections of New Brunswick as a means of providing an outlet for surplus stock and to use up small and otherwise unmarketable potatoes.

The first starch factory to be opened in the Province is nearing completion at Hartland, Carleton County, where it will be under the management of Messrs. Hatfield and Company, who have been looking up new markets for starch, potato flour and dextrine. The first order for potato starch is from the largest window shade and curtain manufacturers in Canada.

The plant at Hartland, when running full capacity will handle potatoes at the rate of 400 barrels per day. The Provincial Government guarantees carrying charges on stock produced while on hand up to a valuation of $10,000. It is expected that other plants will be established in commercial potato-growing sections of the Province. The New Brunswick Department of Agriculture is also taking vigorous steps to encourage mixed farming in the potato districts to guard against over-production and to stabilise the agricultural industry of the Province.

THE DEVELOPMENT OF SIZING TECHNIQUE.

For many years sizing has been regarded in rather a secretive light, and it is only of comparatively recent date that the details of machine construction and design have been freely disclosed. This step, however, has been rendered more or less essential in view of artificial silk's rapidly extending utilisation. Initially, artificial silk employed as warp was, in general, a two-fold yarn, the lustre and important feature "fullness," being consequently very appreciably reduced. Subsequent developments in the yarn structure produced a multifilament yarn of superior strength, with good wearing power and a greatly enhanced lustre. In this form the greater proportion of artificial silk is employed by the manufacturer today. In weaving, however, considerable difficulty was experienced at first with the filament structure, and this became all the more accentuated when comparison was made with the folded yarn previously employed. It was found necessary to introduce a process whereby the filaments could be worked into a form more solid and firmer, so that weaving would be effected with a greater degree of efficiency and with a minimum of cut filaments. The necessity for this process of sizing will be more easily understood when it is remembered that relative to cotton the artificial silk yarn is practically devoid of twist. Although the synonymous term "sizing" is applied to both cotton and artificial silk yarns, the nature of the operation in the latter instance differs from that applied to cotton.

Within the past five years much attention has been devoted to the sizing of artificial silk, for, apart from the rapid development of the industry, the question of loom

efficiency has been involved. At the outset, the weaving of the filament structure in warp form created a relatively low loom efficiency and was the cause of much trouble and anxiety to both weaver and manufacturer. A few firms, however, made a special study not only of the process but also of the industry, and the main difficulties have been overcome. The progress made in artificial silk sizing has permitted extensive developments in fabric design and production and has had a considerable influence on the recent expansion of the industry.

The increasing popularity of fine filament and denier yarns, the weaving of which involves a greater degree of skill, for example, is really due to an efficient sizing system. (Abstracted from the *Artificial Silk (Rayon) World.*)

CADMIUM IN CANADA.

Cadmium was produced in Canada for the first time in 1928, the output, according to a statement recently made by Mr. Arthur Buisson of the Dominion Department of Mines at Ottawa, amounting to 491,894 pounds valued at $341,274. All the cadmium produced in Canada is exported; most of it to Europe and some to the Orient. Cadmium is not mined as an ore but is a by-product obtained in the production of zinc and, in some cases, of lead, being associated in small amounts with these metals in their ores.

The recovery plant of the Consolidated Mining and Smelting Company at Trail, British Columbia, which started producing early in 1928 has been treating accumulated cadmium residues from its zinc plant and is producing refined cadmium. In other countries cadmium is marketed not only as metallic cadmium, but also as cadmium sulphide. In the metallic state cadmium rarely contains 0.5 per cent. impurities.

The Hudson Bay Smelting and Refining Company plans to erect a zinc refinery at the Flin Flon Mine in northern Manitoba. It is also reported that two new zinc refineries may be erected in eastern Canada—one by the Consolidated Mining and Smelting Company in association with Ventures, Ltd., near Sudbury, Ontario, and the other by Noranda Mines, Ltd., in association with the Nichols Copper Company. It is possible that these plants may eventually procadmium residues, and may erect the necessary recovery plants if conditions justify such a course.

During the past year the market for cadmium has been buoyant, owing to the fact that the application of this metal for plating purposes has developed rapidly and increased the consumption beyond expectations. Cadmium is also being employed by colour makers to a greater extent because of the increased use of "cadmopone." It is used in the manufacture of fusible alloys as an ingredient of special amalgams, and salts of cadmium find application in the arts and in medicine, and in the dyeing and other industries.

The price has been characterised by some remarkable fluctuations. In 1928 it increased 100 per cent. to a maximum of about 90 cents a pound. The present London price is 4s. 6d. while the New York price is 85 to 90 cents a pound. The United tates product is protected by an import duty of 15 cents a pound.

The world's production in 1928 was estimated at 1,100 tons. The chief producers are the Anaconda Company in the United States; the Electrolytic Zinc Company of Australia; the Consolidated Mining and Smelting Company of Canada, and the American-Geische A.G., in Upper Silesia.

FLUORINE MONOXIDE.

The preparation of fluorine monoxide, F_2O, has been effected by P. Lebeau and A. Damien (*Comptes Rendus*, 1929, CLXXXVIII, 1253), who have obtained the gas by the electrolysis of a solution of potassium fluoride in hydrofluoric acid and a little water. Fluorine monoxide accompanies the oxygen disengaged by the action of elementary fluorine on water.

A better yield of the gas is, however, obtained by passing fluorine through a solution of sodium hydroxide when the following reaction occurs,

$$2F_2+2NaOH=2NaF+F_2O+H_2O$$

The gas is purified by washing with water and then liquefying the gas in liquid air at $-165°$ C. when its density is 1.835.

SHELLAC.

Shellac is the resinous exudation of the lac insect, *Tacardia Lacoa*, which attacks the young shoots of certain trees and in the course of this produces the shellac. This is a product peculiar to India and Burma. A little is also produced in French Cochin China. The analytical examination of

shallac has become of importance in recent years although it has been very much neglected in the past. Messrs. Angelo Bros., 45 St. Mary Axe, London, E.C.3., shellac manufacturers in Calcutta, have issued a booklet giving a description of the usual procedures and this will be sent to anyone interested on application.

INTERNATIONAL NICKEL COMPANY OF CANADA, LTD.

STATEMENT FOR THE THREE MONTHS ENDED 31ST MARCH, 1929.

The Consolidated General Balance Sheet and the Consolidated General Profit and Loss Statement for the quarter ended 31st March, 1929, shows a very favourable comparison with the previous quarter and the corresponding quarter of 1928. The demand for nickel has been very well maintained both in America and in Europe and the company is finding difficulty in fulfilling its orders. Lord Melchett has had the opportunity of frequent consultations with Mr. Robert C. Stanley, the President of the Company who has recently spent some considerable time in England going through the organisation of the company on this side. As a result of his visit the extension of the property of the Mond Nickel Company has been decided upon. The extensions include additions to refining and smelting plant at Clydach and developments at the Birmingham and Acton works.

The development of the Frood Mine is continuing in a very satisfactory way. It has always been stated that a considerable period must elapse before any practicable output would be obtained from the development of a mine of this size. With care and time the prospects which have already been forecast for this mine will unquestionably be realised.

The closer co-operation of the companies has already pointed the way to a number of new methods and improvements which will increase the profits in the future. All depletion and depreciation charges have been deducted on a generous scale and all taxation has been taken care of before the figure for profit has been arrived at.

British shareholders should note that in due course they will obtain relief from Canadian income tax which will be paid by the company. Such relief amounts to a maximum of 2s. in the pound.

ALUMINIUM PAINT TO BE USED ON NEW U.S. CRUISERS.

Department of the Navy Bureau of Construction and Repair General Information Bulletin No. 1-27 outlined results obtained in tests of aluminium paint and indicated that it would probably be much more widely used in naval vessels because of its light weight and excellent properties.

The first important extension of the use of aluminium paint was the authorisation in May, 1927, of its use as a priming coat, in place of red lead, on exterior and interior metal surfaces of the "Salt Lake City" and "Pensacola." As aluminium paint has a tendency to soften and blister when continuously submerged or subjected to protracted periods of submergences in fresh or salt water, its use was not authorised on the outer surfaces of the hull below the second deck level or on interior surfaces subject to immersion, as in water tanks and bilges.

The varnish vehicle of aluminium paint will not withstand exposure to petroleum products, and accordingly aluminium paint was not authorised for use in fuel-oil tanks. Neither was it authorised for use on decks to be covered with wood planking. These surfaces can not be kept under observation, and it was not considered desirable to use an experimental coating.

In September, 1927, the use of aluminium paint on the "Salt Lake City" and "Pensacola" was further extended to include applications as a finishing coat for a large number of spaces, such as magazines and storerooms.

Reports from the above vessels indicated that aluminium paint, under the conditions of ship constructions, was giving as satisfactory results as red lead and that it possessed advantages over red lead, such as saving in weight, improved interior lighting of the ship, more agreeable working conditions, greater ease of inspection, and better appearance.

Accordingly the use of aluminium paint has recently been authorised for light cruisers 26 to 31, inclusive, with the same limitations as in the case of the "Salt Lake City" and "Pensacola."

—*The American Metal Market.*

SUDANESE TRADE IN 1928.

A general increase over the previous year is shown for 1928 in the value of foreign trade. Advances were made in imports of sugar, tea, textiles and motor vehicles, among other items.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

Papers read on Friday, May 24 :—

A Hygrometer for Use in Timber Seasoning Kilns. By EZER GRIFFITHS, D.Sc., F.R.S., Physics Department, National Physical Laboratory, Teddington, Middlesex.

The hygrometer is of the wet and dry bulb type using mercury in steel thermometers. The bulbs and capillaries are enclosed in a steel tube which can be inserted through a hole 3 in. in diameter and explorations up to 12 ft. can be made with it. One dial serves both thermometers, the two pointers being arranged so that one moves over the top face of the dial and the other is brought round from beneath on to the outside edge. An electrically operated fan draws air past the two bulbs. The moistening of the covering over the wet bulb is effected in two ways : (*a*) by a reservoir, (*b*) by connection to an external water supply.

Experiments on Magnetostrictive Oscillators at Radio Frequencies. By J. H. VINCENT, M.A., D.Sc., F.Inst.P.

An account is given of the behaviour of two magnetostrictive oscillators 6 mm. and 4.5 mm. in length, when placed in a coil in series with the main induction coil of a simple valve-maintained oscillating circuit. The frequency characteristic of the smaller oscillator is 540 kc. per sec.

A demonstration of an apparatus for measuring the Thermal Expansion of Glass was given by Professor W. E. S. Turner, O.B.E., F.Sc., M.Sc.; and of the Flutter Model Aeroplane Wings by R. A. Fraser and W. Duncan, The National Physical Laboratory.

MELLON INSTITUTE OF RESEARCH, PITTSBURGH UNIVERSITY, U.S.A.

This Institute has issued an interesting booklet entitled, Science for the Home Manager," which contains many useful talks which were broadcast during the winter from the University of Pittsburgh studio, under the auspices of the Mellon Institute. These "talks" were selected with the idea of giving a general idea of the recent developments in household economies, resulting from the application of the scientific method to domestic problems, each talk being delivered by an expert. The talks will prove not only interesting but really helpful, because of the useful and varied information which they contain.

NOTICES OF BOOKS.

Elektrostatik in der Biochemie. (A series of lectures at Basle, October, 1928, reprinted from the *Kolloidchemische Beihefte*). Pp. 200-390. Dresden and Leipzig : Theodor Steinkopff. 1929. Price 10 marks.

The part played by dissolved electrolytes, ions and other electrolytic phenomena in living organisms has hitherto received little attention although the subject has developed extensively in other directions. Under the ægius of the Faculty of Mathematics and Science at Basle University a course of 20 lectures has been given dealing with the present knowledge concerning the electrical phenomena associated with living matter. The present volume collects together these lectures and should prove of special value to biologists and biochemists. The introductory chapter by Dr. K. Spiro (Basle) outlines the history of various observations and deals with various fundamental conceptions in modern physics. Dr. R. Keller, of Prague, deals with electrostatics as a field of research in biology, Dr. R. Furth (Prague) contributes five papers on the physical basis of the electrical potentials in organisms and their direct measurement; the electrical characteristics of solutions, dyes and colloids; disperse systems; measuring the size of particles; and dielectric constants. Dr. K. Umrath gives an account of measurements of potential. Dr. F. Leuthardt (Basle) deals with the biological applications of pH determinations. Other contributions were made by Dr. J. Gicklhorn (Prague), the preparation of microelectrodes; Dr. J. Pekarek (Prague), vital colours in nectaries; Dr. F. P. Fischer (Leipzig), vital colours in the eyes; Dr. L. Ralik (Prague), vital colours in hydraearina; Dr. E. Dejdar (Prague), a new nervous organ in Cladocerae, and Dr. A. Nistler (Prague), dispersoid analysis with dialyses. All these contributions are of outstanding importance in biology and biochemistry.

Practical Chemistry for Matriculation. By JAMES BRUCE, Ph.D. (Munich), B.Sc. (London), F.I.C., AND HARRY HARPER, B.Sc. (London), A.R.C.S. (London), A.I.C. Pp. 228. Price 2s. 6d. London : Macmillan & Co., Ltd., St. Martin's Street, London.

No apology is needed for the issue of this very useful book, which will be found exceedingly helpful to those students who are preparing for matriculation. It will also prove useful to the teacher. It is a practical book and the price places it within the reach of any student, without causing a crisis in his financial affairs. It is illustrated

on almost every page, and there is a well-prepared index.

The Foundations of the Theory of Dilute Solutions. Alembic Club Reprint No. 19. Pp. 67. London : Messrs. Gurney and Jackson, 33, Paternoster Row, E.C. Edinburgh : Oliver & Boyd, Tweeddale Court. 1929. Price 2s. 6d.

After an interval of a dozen years the Alembic Club has published another important text dealing with a landmark in science. The foundations of the theory of dilute solutions were two papers by Arrhenius and van't Hoff. In 1883 the former submitted to the Swedish Academy of Science a memoir entitled Récherches sur la Conductibilité galvanique des Electrolytes, and to the same body van't Hoff presented his paper, Lois de l'Equilibre chimique dans l'Etat dilué, gaseux ou dissous.

These communications formed the basis of the theories of electrolytic dissociation and of osmotic pressure. It was, however, only after their publication in the first volume of the *Zeitschrift fur physikalische Chemie*, 1887, that they attracted attention. It was then seen that each supplemented the other and they have since initiated much useful experimental work. The reprint, in English, of these epoch-making papers is therefore opportune.

The Annual Report, 1928-29, of the British Science Guild, contains the addresses given at the public meeting held at the Mansion House on April 24—1. "Fertilisers from the Air," by Sir Frederick Keeble, C.B.E., Sc.D., F.R.S. (of Imperial Chemical Industries, Ltd.); 2. "Rayon (Artificial Silk)," by A. B. Shearer, F.T.I. (of Messrs. Courtaulds, Ltd.); 3. "Synthetic Drugs," by Francis H. Carr, C.B.E. (of The British Drug Houses, Ltd.). The price of the Report is 1s., and may be obtained from the Guild's offices, 6, John Street, Adelphi, London, W.C.

PUBLICATIONS RECEIVED.

Report to the Rt. Hon. Secretary of State for Home Department in the Circumstances Attending an Explosion on October 15, 1928, at the Factory of the Explosives and Chemical Works, Ltd., Great Oakley, Essex. By H. E. Watts, M.B.E., etc., H.M. Inspector of Explosives. (Cyclostyled). 11 pages. 1929.

U.S. Bureau of Standards.

Circular No. 872. *Recommended Specification for Quicklime and Hydrated Lime for use in Soap-making.* Price 5c.

Thermal Expansion. Price 5c.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, June 26, at 4 p.m.—Annual General Meeting.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

The next Ordinary Meeting of the Society will be held on Wednesday, October 16, 1929, when the Annual Pond Life and General Microscopical Exhibition will be held.

The next meeting of the Biological Section will be held on Wednesday, November 6, 1929.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 19 to September 14, 1929.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Friday, May 31, at 9 p.m.—"The Air Pump : Past and Present." By E. N. da C. Andrade, D.Sc.

Monday, June 3, at 5 p.m.—General Meeting.

Friday, June 7, at 9 p.m.—"Excavations at Ur, 1928-1929." By C. Leonard Woolley.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

14,518.—Adelantado, L.—Manufacture of superphosphates, etc. May 9.

14,721.—Distilleries des Deux-Sevres.—Concentration, etc., of organic acids occurring in aqueous solution. May 10.

14,476.—Fleck, A.—Production of quicklime and sulphur dioxide. May 9.

14,601.—Fletcher, W. B., and McAulay, J., and Wheeler, T. S.—Preparation of carbon bisulphide. May 10.

14,269.—Imperial Chemical Industries, Ltd., Wheeler, T. S. and McAulay, J.—Removing hydrogen from gases. May 7.

Specifications Published.

285,426.—Boshringer, A.—Manufacture of maleic acid and maleic anhydride.

291,382.—I. G. Farbenindustrie Akt.-Ges. —Apparatus for the production of carbon disulphide.

Abstract Published.

308,566.—Disodium phosphate.—Benckiser, T., Reimann, A., and Reimann, A. (trading as Benckiser, J. A., 30, Frankenthalerstrasse, Ludwigshafen-on-Rhine, Germany.

Disodium phosphate having two molecules of water of crystallisation is obtained directly from a pure solution of the salt by crystallication above 50° C. The solution may be obtained by neutralising with soda or soda lye purified concentrated phosphoric acid containing 600-700 grms. P_2O_5 per litre; or a more dilute solution may be used and be evaporated under reduced pressure until crystals precipitate.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

B.A.A.

500,089.—Acid used for filling accumulators and batteries.—F. W. Berk & Co., Ltd., 106, Fenchurch Street, London, E.C.3. May 15.

METDURO.

500,750.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives. — Metropole Developments, Ltd., Metropole House, Finsbury Square, London, E.C.2. May 15.

BIGESTIVE.

496,768.—Chemical substances prepared for use in medicine and pharmacy. George Richard Williamson, trading as Lester & Williamson, Great Heath Pharmacy, 428, Foleshill Road, Coventry. May 15.

BROSEDAN.

501,513.—Chemical substances prepared for use in medicine and pharmacy.—Hermann Temmler, trading as TemmlerWerke Vereinigte Chemische Fabriken, Flugplatz 6, Berlin-Johannisthal, Germany. May 15.

" CHEMICAL NEWS "—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, " CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered througn any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

URGENTLY WANTED TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.
also
No. 3400 Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3608.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

Polarographic Studies with the Dropping Mercury Cathode. Part I.—The Amphoterity of Ferrous Hydroxide 354
By B. Schrager.
An Outline of the History of Medicine in India 356
By Captain P. Johnston-Saint.
Electric Current and Energy Transmission 360
General Notes:—
Humber Oil from Coal Scheme 361
International Rayon Statistics 361
New F.B.I. Headquarters 362
James Young Memorial 362
Wreath on Sir Humphry Davy's Tomb 363
United States Department of Agriculture 363
Chemicals from Tree-Stumps 363
1,500,000 Tons Coal Contract 363
South Australian Trade 364
Proceedings & Notices of Societies:—
The Royal Society 346
Notices of Books 346
Forthcoming Events 367
New Patents 367
New Trade Marks 368

HIGHER CHEMICAL INSTITUTE, ITALY.

seeks Teachers for the Scientific Part and Practical Doctors of Chemistry in Derived Anthracene Carbazol Dyes. First rate men. Offers, with curriculum vitæ, requirements and particulars of specialities to "Uc. 20 V." Unione Pubblicita Italiana, Milan (Italy).

HOLLAND.

WANTED,
AGENCIES OF FIRST-CLASS BRITISH FIRMS

by Dutch Mercantile Gentleman, just returned from BRITISH INDIA, where he has represented for many years a large German Concern of the Chemical Industry.

Please write to—A. M. H., 267, c/o N. V. RUDOLF MOSSE, AMSTERDAM, HOLLAND.

CHEMICAL ENGINEER WANTED

for a Large Undertaking. Should be over Thirty, under Fifty. Must be thoroughly experienced as DESIGNER and have some experience in operating Chemical Plant, such as Heavy Chemicals, Gas Products, Metallurgical Plants. Good salary.

Write personal details and fully as to training and experience, to "PROCESS," care of Dawsons, 118, Cannon Street, London, E.C.4.

ALEMBIC CLUB REPRINTS of Historical Publications. **No. 19.** Just Published. Crown Octavo. Cloth. Price 2s. 6d. Post Free 2s. 8d. (To U.S., $0.65.)

THE FOUNDATIONS OF THE THEORY OF DILUTE SOLUTIONS. Papers on **Osmotic Pressure,** by **J. H. Van't Hoff,** and on **Electrolytic Dissociation,** by **Svante Arrhenius,** 1887.

Edinburgh: Oliver & Boyd, Tweeddale Court.

London: Gurney & Jackson, 33, Paternoster Row.

POLAROGRAPHIC STUDIES WITH THE DROPPING MERCURY CATHODE. PART I. — THE AMPHOTERITY OF FERROUS HYDROXIDE.*

By B. Schrager.

Whilst the acidity of higher oxides of iron is distinctly shown, that of ferrous oxide or hydroxide has hitherto escaped attention. Yet polarographic investigations of alkaline solutions to which traces of ferrous compounds were added show that ferrous hydroxide is slightly soluble in such solutions, displaying acidic properties.

Concentrated solutions of sodium, potassium or lithium hydroxides, prepared even from purest specimens, when examined polarographically, always show an impurity which manifests itself in the form of a "wave" on the current-voltage curve at the cathodic potential—1.5 volt see Fig. 1, curve 1).

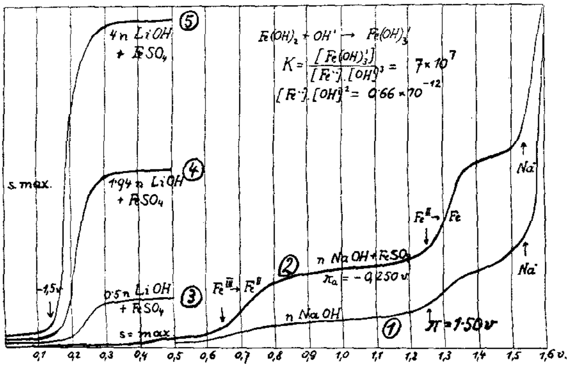


Fig. 1.

A closer examination has shown that this "wave" is due to iron which is present as an impurity in true solution in the divalent form. From the position and dimensions of the wave the acidic constant of ferrous hydroxide has been deduced.

The apparatus used has already been described in numerous communications (*e.g.*, J. Heyrovsky, *Rec. trav. chim.*, 1925, XLVI, 488; *Bull. Soc. chim.*, 1927, XLI, 1224; S. Prát, *Handb. d. biolog. Arbeitsmeth, Abderhalden*, 1928, III., A. II., 1413). It consisted of the "polarograph" machine photographically registering current-voltage curves and the dropping mercury cathode with the necessary moving-coil mirror galvanometer of a sensitivity 6.10^{-9} amp. per mm. scale. Since the greatest sensitivity of the method was used throughout, the solutions had to be entirely freed from atmospheric oxygen, which was effected by passing pure hydrogen through them for several hours, usually overnight. The ferrous solutions added to the alkaline solutions were similarly carefully freed from oxygen and the mixing was always carried out in an atmosphere of hydrogen. For this a burette arrangement has been used as described in the communication of Emelianova and Heyrovsky (*Trans. Faraday Soc.*, 1928, XXIV, 267).

Experimental.

As already pointed out polarograms of sodium hydroxide solutions show an increase of current "waves" at a cathodic potential—1.50 volt from the potential of the normal calomel electrode; the wave increases with the concentration of the alkali. The height of the wave shows that it is caused by electro-reduction of a substance present in a concentration of 10^{-5} to 10^{-4} normal. From amphoteric or acidic hy-

* Communicated by J. Heyrovsky at the 6th Congress of Czechoslovak Natural Scientists, Physicians and Engineers, Prague, May 27, 1928, and abstracted from *Collection of Czechoslovak Chemical Communications*, May, 1929, p. 275.

droxides, which alone can be present in the alkaline solution and would deposit at about this voltage, that of zinc is the nearest (—1.38 volt), which position is, however, distinctly different from the one observed in these experiments.

The common impurity, iron, was suspected, since addition of potassium cyanide removed the wave almost entirely. Here it has to be mentioned that from a solution of potassium ferro-cyanide iron cannot be electro-deposited (E. B. Sanigar, *Rec. trav. chim. l.c.*, p. 549), whereas from zinc cyanides zinc is distinctly electrodeposited at the dropping mercury cathode (*I. Pines, Dissertation*, Charles' University, 1928).

Addition of ferrous and ferric salt.—Next one cc. of a millinormal solution of ferrous sulphate was added to about 20 ccs. of the alkaline solution (in an atmosphere of hydrogen); this effected a considerable increase of the impurity wave, assuring us that the substance which is reduced at the potential —1.50 v. is a compound of iron in solution. This experiment was repeated many times and the same effect was always observed, whenever a ferrous solution was admixed with a concentrated alkaline solution, both having been previously freed from air.

Striking changes of the electrode-potential of mercury which serves as anode at the bottom of the electrolysing vessel are observable after the addition of even very small quantities of the ferrous solution : the potential of mercury, which in a normal alkaline solution is about —0.200 volt even with additions of 5.10^{-5} *gr eq.* $F\ddot{e}$ per litre becomes in few hours by more than —0.90 volt negative to the normal calomel zero.

Changes to considerably negative values of the mercury potential, attained some time after the traces of admixtures are dissolved in the alkaline solution were observed by J. Smrz (*Rec. Trav. chim., l.c.*, 580) when a stannous solution was added to an alkaline solution; but never in cases when salts of stable valencies are added to alkaline solution, *e.g.*, when plumbites or zincates are formed.

The processes of charging the mercury negatively have thus to be sought in the strongly reducing tendency of the ferrous admixture, represented by the reaction

$$F\ddot{e} \longrightarrow F\dddot{e} + \ominus.$$

Since, however, in the normal alkalies only ferrous and ferric hydroxides may exist, which are electro-chemically active, they must be in true solution present with a definite active mass, *i.e.*, as amphoteric hydroxides, functioning here as acids, forming anions like $Fe(OH)_3'$ and $Fe(OH)_4'$.

The additions of a ferric solution to these alkaline solutions, admixed similarly as in the case of ferrous sulphate, have not affected the mercury potential; however, the current voltage curve showed next to the wave at —1.5 volt a new wave at —0.8 till —0.9 volt (see Fig. 1, curve 2). The latter potential coincides with the most negative values of the mercury potential attained in the ferrous alkaline solution. According to the reaction suggested above, both values should indeed be equal to the reduction potential of a ferrous-ferric mixture in alkaline solution.

Thus the two waves observable on the polarographic curve when ferrous and ferric salts are added to an alkaline solution are : 1. that at —0.8 v is the reduction stage of ferric hydroxide to the ferrous; 2. that at —1.5 v, the deposition of iron from the ferrous hydroxide (Fig. 1, curve 2).

Saturation by ferrous hydroxide.—It has already been mentioned that after the ferrous hydroxide appears in the alkaline solution, the impurity " wave " at —1.50 v. slowly increased to a limiting value; the maximal height which was observed in the 1.375 n *NaOH* solution was 8 cms, already reached when the addition of the ferrous solution brought into the alkaline solution amounted to 7×10^{-5} gr. equiv. per litre. Further additions did not cause any increase above this dimension. Thus the alkaline solution seems saturated with freshly precipitated ferrous hydroxide, the concentration of this solution, *i.e.*, the solubility, being of the order of 7×10^{-5} n. This value coincides also with the height of the wave, since 12 cms corresponded to 10^{-4} *gr. eq.* of reducible substance per litre in the arrangement used. After standing several days the wave decreased, which is easily explained by the " ageing " of the precipitated hydroxide, which thus decreases in solubility.

If the concentration of the alkali hydroxide was varied, the height of the " wave " due to the solution saturated with the ferrous hydroxide changed in exact proportion to the strength of the alkali. Fig. 1, curve 3, shows this important relationship which at once proves that the ferrous hydroxide dissolves in alkalies by reacting with them as a monobasic acid. The equation

$$Fe(OH)_2 + OH' \longrightarrow Fe(OH)_3'$$

gives

$$\frac{[Fe(OH)_3']}{[OH']} = K.[Fe(OH)_2] = K_A$$

in the presence of solid $Fe(OH)_2$.

Thus the dissolved portion of the ferrous hydroxide, $Fe(OH)_3{}']$, must increase proportionally with the concentration of hydroxyl ions.

We are now able to calculate the constants of acidic and basic splitting of the ferrous hydroxide.

The basic and acidic constants of ferrous hydroxide.—The constant of the ionisation equilibrium

$$Fe(OH)_2 \rightarrow Fe^{\cdot\cdot} + 2OH',$$

viz., the ionic product $[Fe^{\cdot\cdot}].[OH']^2$ which is the basic constant, K_B, is calculated from the concentration of the free ferrous ions existing in the alkaline solution.

Knowing that ferrous ions deposit from a normal solution at the potential of —1.115 v. (J. Heyrovsky, *Trans. Faraday Soc.*, 1924, 19, 692) and from the 1.375 n $NaOH$ solution at —1.51 volt, we deduce from the deposition shift 0.39 volt, that the concentration of free ferrous ions in the alkaline solution is 4×10^{-13} gr ions per litre.

Then

$$K_B = [Fe^{\cdot\cdot}].[OH']^2 = 4 \times 10^{-13} \times (1.375)^2 = 7 \times 10^{-13}.$$

The constant of the acidic reaction of the ferrous hydroxide,

$$K_A = \frac{[Fe^{\cdot\cdot}(OH)_3{}']}{[OH']} = \frac{7 \times 10^{-5}}{1.375} = 5 \times 10^{-5}$$

Th complexity-constant of the anion $Fe(OH)_3{}'$, derived from K_A and K_B, is

$$K_C = \frac{[Fe(OH)_3{}']}{[Fe^{\cdot\cdot}].[OH']_3} = \frac{5 \times 10^{-5}}{7 \times 10^{-13}} = 7 \times 10^{+7}.$$

Acidic dissolution of cobaltous and manganous hydroxides.—Similar additions to these of ferrous solutions were also carried out with cobaltous, nickelous and manganous salt solutions to concentrated alkalies. The resulting solutions, containing some precipitate of the hydroxides were examined polarographically.

Distinctly acidic properties were shown by cobaltous and manganous hydroxides, which dissolve slightly in excess of alkalies giving rise in a 1.96 n $LiOH$ solution to waves of 4.2 cms $Co(OH)_2$, 4 cms with $Mn(OH)_2$, whilst no effect was given with $Ni(OH)_2$; the $Fe(OH)_2$ produced a wave 9.8 cms high. The cobaltous wave occurs at —1.4 volt, that due to manganous additions at —1.8 volt from the potential of the normal calomel electrode. No further investigations of this amphoteric dissolution were carried out.

AN OUTLINE OF THE HISTORY OF MEDICINE IN INDIA.

By CAPTAIN P. JOHNSTON-SAINT, M.A. (Cantab.), F.R.S. (Edin.).

THE SIR GEORGE BIRDWOOD MEMORIAL LECTURE, *delivered before the Royal Society of Arts, on Friday, May 10. Sir E. Denison Ross, C.I.E., Ph.D., Professor of Persian and Director of the School of Oriental Studies, University of London, presiding.*

(*Continued from page 343.*)

The Hindu Surgical Instruments.

And if their preventive medicine, their midwifery and toxicology were thus thorough we may be certain that at least equal pains were taken with the instruments of the Hindu Fathers of Surgery. I have already casually mentioned the remarkable number of the classes of instruments, but the subject deserves far more than any such cursory glance.

We may take it that in the beginnings of all things some sort of primitive surgery was in use with naturally primitive implements, and long before the Vedas were ever set down in writing such crude instruments as bits of obsidian or glass, or skins of bamboo were employed for surgical incisions. Susruta, in codifying the knowledge of his day, had no intention of abandoning altogether the past, and in setting out on a voyage of independent discovery. We, therefore, find all these primitive surgical instruments described in his armoury and with them the more practical instruments, discovered by the experience of centuries.

So there are the Yantras and the Sastras, the blunt instruments and the sharp. Of the blunt twenty-four kinds were cruciform, two kinds pincherlike, two pick-lock like, twenty tubular, twenty-eight rod or prickerlike, twenty-five accessory and there is the same sort of variety of the sharp instruments. In general they were made of iron and their jaws as a rule were fashioned to resemble the faces of birds and beasts. So there were forceps with jaws shaped to resemble that of a tiger, the wolf forceps, the bear forceps, the butcher bird forceps, the crocodile forceps, the heron forceps, and many others similar.

One remarkable point is that precisely on the pattern of Simhamukha svastika, or lion faced forceps, described by Susruta, are the forceps now used by modern European surgeons for holding bones firmly during operations; the surgeon names his instru-

ment " lion forceps." Although, of course, no original specimens of these instruments have survived, a very comprehensive set of exact replicas are to be seen at the Wellcome Historical Medical Museum, and I must mention here that my special thanks this afternoon are due to Dr. Wellcome, the Founder and Director of this Museum, for his kindness in allowing me to use material both for the lantern slides and for the exhibits, and also to the Conservator, Mr. Malcolm, and to Mr. Hewitt, the Chief Librarian, for their help and assistance. On examining these instruments, they will be seen to be remarkably similar to those in a catalogue of a modern surgical instrument maker. More remarkable still perhaps is the fact that in many cases we can trace their exact geneological descent down to our own day, for we have descriptions of many of the instruments of the ancient Greeks, Romans, and Arabs, and in case after case they tally exactly with those shown here as ancient Hindu.

More, with the destruction of Pompei many instruments were buried under volcanic ash and being centuries later disinterred are now to be seen preserved in the Naples Museum. These, too, tally in exactly every detail with many of our descriptions of the instruments of the Hindu surgeons as given in the old Sanskrit manuscripts.

Exact instructions are laid down for the building of a dispensary, even for the cases in which instruments are to be kept. Dentistry is described and students were advised to practise extraction on certain fruit seeds and on the teeth of dead animals. At some period unknown, but certainly before the 12th century A.D., false teeth were known to the Hindus. A description of the defeat of Jayacandra by Sahabuddin in 1194 mentioning the dead body of the rajah being " recognised by his false teeth." This curious passage, however, I only notice as of casual interest, its date of course being long posterior to the period with which we are dealing.

Hindu Materia Medica.

If, then, this is what we find in surgery, what may we not expect in medicine from India, that vast and fertile country which by the very nature of its size and climate is indeed a veritable encyclopædia of the vegetable world? Nor shall we be disappointed. The materia medica of the ancient Hindus is a marvel to the modern scientific investigator; and that it was freely borrowed from by both Greeks and Romans cannot be denied.

Charaka makes an arrangement of " simple medicines " only, under no less than forty-five heads; Susruta, being more given to surgery, divides his medicines under thirty-seven heads. These masters passed on their teachings to their pupils who in turn supplemented them with new drugs, the fruit of their own experience. So we have Vagbhata about the second century B.C. and his stupendous Ashtangahridya, a sort of encyclopædic compendium of the medicine of Agnivesha, Charaka and Susruta; Madhava and his diagnosis of disease was another giant, and there was Bhava Mishra of Benares, the " Jewel of Physicians," and plenty more. The list of Indian medical writers could continue almost indefinitely.

In the Materia Medica are described drugs belonging to the animal, vegetable and mineral kingdoms, the theory being that every substance had to be judged by its five properties, Rasa, Guna, Veerya, Vipaka, and Prabhava. The first of these stood for taste, sweet, sour salt, bitter, pungent or astringent, the sweet being more restorative than the sour, the sour than the salt, and so on. The second property, Guna, was virtue, the inherent power of the drug to cause a certain effect when taken internally or externally; under this heading Charaka gives fifty groups of ten herbs each which he says " are enough for the purposes of an ordinary physician." 'Agnivesha, on the other hand, gives no less than 500 classes alone of medicinal agents. Veerya stands for the power of a drug, being either heating or cooling. Vipaka was the consequence of action or change which the drug underwent in the human organism, and finally Prabhava was its adherent nature or active force.

So two drugs might both be sweet, both be heavy and both be cold and both remain similar in consequence of gastric action, and yet in effect or Phabhava the one might be costive and the other laxative. With the combined action of these five properties, in the case of many hundreds of drugs as applied to different patients with different types of disease, the physician had to make himself familiar, for as the sages had it: " Medicine when administered by an ignorant person is compared to poison, being like the knife, lightning or fire; but when administered with the necessary knowledge, medicine is like the Amrita, or water of immortality."

The arrangement of Materia Medica in Susruta is curious according to our idea of medicines being either locomotive or non-

locomotive. Among the former fall animals whether viviparous or oviparous or "produced in moist places."

Long lists of medicines are hardly to our purpose, but in the Kalpastanum we might notice the classification of drugs and medicinal plants under their headings of Tuberous and Bulbous Roots, Bark of Roots, Bark of Trees, Trees possessing a peculiar smell, Leaves, Flowers, Fruits, Seeds, Acrid and Astringent Vegetables, Milky Plants, Gums and Resins. The list is interesting as it is in this book that we probably find our earliest notices respecting Botanical Geography, the sites and climates of different plants, the soils and seasons for collecting medical plants, the time that they remain good, how they are to be kept and the weights and measures of pharmacy. This Botanical Gardening coupled with the Indian pharmaceutical gardens which I shall refer to presently seems to possess a particular interest in medical history, and again it is to India that we owe it.

Many of these medicines can be traced driectly, not only down to the Arabs but also to the Greeks and Romans. Dioscorides in his first book mentions many Indian plants particularly among aromatics for which India has always been famed. Galen and Pliny also borrowed much, but it is the work of Dioscorides that is best calculated to show to how great an extent the ancients were indebted to India and the East for their medicines. There were some who used to think that the Hindus had their knowledge from the physicians who accompanied Alexander the Great on his conquests in the East, but we now know that it was to India that the Greeks, and so indirectly ourselves, owe most of their medicines. How this came about I hope soon to show. And while many drugs that had their origin in India have found their way into our own British pharmacopœia, there were probably hundreds more Indian medicines still unacknowledged. Much as we have learned, it is possible that there still remain rewards richly to repay patient research.

The Indian State System of Medicine.

With the coming of Buddhism, practical surgery underwent a still further fall. The teaching of the Buddha, the Enlightened, did not, it is true, totally prohibit the use of the knife, and it was for instance permitted to lance a boil. But on the whole it is fair to say that surgery under the new creed was so shackled and hedged with limitations that it almost disappeared.

The student was to practise puncturing "on the veins of dead animals and on the stalks of the water-lily," while his extractions were to be made experimentally on the pulp of various fruits and on the teeth of dead animals. Flowers, bulbs, and gourds were all pressed into service as models for the dissecting table. Incisions were demonstrated on bladders packed with mire and paste lancing on hollow stalks of plants, scarification on the fresh hides of animals "from which the hair had not been removed." Models of the human limbs were fashioned for lessons in bandaging, and so the regulations went on indefinitely.

But while surgery was limited, other branches of medicine under the Buddhism that now ruled the greater part of India advanced by leaps and bounds. A creed of tenets that embraced in their care the veriest insects could but pay infinite care to the ailments and ills of man himself; and so we find the whole of India soon covered with a perfect net-work of medical machinery. In the scheme of life in fact of the Buddhist priest of 200 B.C. was included the assistance of the sick, and so we have hostels for the sick and blind, the deformed; there were hospitals for pregnant women, hospitals for travellers. Buddha Das, we are told, established the system of State Physicians, one being appointed for every ten villages on the great roads of India.

Pharmaceutical Gardens were established to supply the herbs and drugs in Ayurvedic medicine. Arboriculture and irrigation were carried out under State supervision. In the line of Preventive Medicine laws were passed regulating burial and sanitation, many modern regulations in the latter direction being antedated by centuries in the codes of the Buddhist Kings. The Royal Household set an example to their subjects in the direction of their houses and gardens. Medicinal herbs were grown in pots and certain plants were grown that had the property of warding off snakes; cats, peacocks and other creatures were kept in compounds for the same purpose, and parrots were encouraged on the grounds that their shriek was a warning of the presence of snakes. And anti-adulteration laws were drawn up on lines of strictest severity, and even carelessness on the part of a doctor was vigorously dealt with. "All physicians," the code said, "who treat their patients wrongly shall pay a fine." But as one commentator had it, "This refers to cases when death is not the result of the wrong treatment, for if that is the case the punishment is greater.

Under Buddhism veterinary science, as we might have expected, reached an enormously high level and infinite pains were taken for the care and treatment of the animal creation. Horses, elephants, cows, fishes, game-birds, almost everything had its veterinary surgeon; the game-keeper, the superintendent of forests, the superintendent of horses, each became a high officer of the Buddhist State.

Under the government of Chandra Gupta (c. 316 B.C.) our modern system of bird and animal sanctuaries was forestalled and whole tracts were devoted to the preservation of birds, fishes, deer and other animals that did not apparently prey on life. It was no case of Forest Preservation in our English history book sense of the Norman Conquerors. Life within the Buddhist reserves was literally and absolutely sacrosanct; the Little Brother of the Christian Saint Francis had veritably come into his own under the codes inspired by Buddha. Regulation after regulation was laid down dealing with the minutest details of the proper rations to be given to different animals at different ages, in sickness and in health, and over their ailments was lavished a care which centuries later a European peasant might well have envied. All over India at the height of the Buddhist wave were set up Animal Hospitals managed for the most part by the State and staffed by the State's own veterinary doctors; the term is probably more accurate than that of the more obvious veterinary surgeons which almost came to my lips. It was the Apotheosis of the Animal World. Centuries later we can still find traces of these Animals Hospitals in various parts of India and particularly amongst the Jains. This then was the state of Medicine in India at one of its most glorious epochs.

Spread of Indian Medicine.

I hope that although with several digressions I have been able to interest you in the early medical science of India and at the risk of a certain loss of strict continuity to present something like a clear story of its glories. I am now anxious, if your patience permits, to touch upon its almost marvellous spread throughout the whole then-known world. For India was no Hermit State, and the knowledge of its Sages was a fountain-head from which every country has liberally drawn. As Jacolliot remark., "We should not forget that India, that immense and luminous centre in olden times, besides spreading its ideas throughout the East by means of emigration, from the earliest times, was in constant communication with all the people of Asia and that all the philosophers and sages of antiquity went there to study the science of life."

Buddhism came and the Brahmin priests fled to the furthest parts of the known world. The Buddhist Dynasties sank, Brahminism was recreated and Buddhist scholars, like those Greeks who with the fall of Constantinople brought the Renaissance to Western Europe, fled with their learning to China, to Tibet, to everywhere. There are even those who say that Ancient Mexico owes much of her pre-Conquadistor civilisation to the arts of India, and the discoveries made by Dr. Thomas Gann in his recent expeditions to Central America disclose in a startling manner the striking similarity of the design and architecture of some of the Maya temples to those of ancient India.

Hippocrates we know to have visited India. For what? save the fame of the Indian physicians. According to a tale brought home to Greece at the time of Alexander the Indians had a doctor whose skill was such that "he could raise the very dead." Stories such as these, however exaggerated, speak wonders and in Greek medicine, in Arabian medicine, in what we know of Egyptian medicine, we find time after time traces of what can only have been derived from the even more ancient and famous Indian medicine. If we were to speak the truth we must call Greece not the parent of our modern medicine but its nurse.

CHESTER SOCIETY OF NATURAL SCIENCE AND ART.

The Chester Society of Natural Science, Literature, and Art has elected Emeritus Professor Robert Newstead, F.R.S., as its president. He is well known for his work while in the chair at the School of Tropical Medicine, Liverpool, and his recent discoveries in connection with the Roman Camp at Chester. The honorary general secretary (Mr. David L. Miln, F.L.S.) reported that the Society's general and sectional meetings, field meetings and nature study competitions had been widely appreciated. Some of the essays received from the school children were of a remarkably high standard, and by means of these competitions the Society hoped to inculcate a real desire for the understanding of the various sciences. The Kingsley Memorial Medal for 1929 was awarded to Mr. S. Gordon Smith, F.E.S., F.L.S., of Chester, for his work in entomology.

ELECTRIC CURRENT AND ENERGY TRANSMISSION.

Having discussed the phenomena of magnetism in these pages (see *Chemical News*, 1928, *137*, 353; 1929, *138*, 116, 161, 173) and having given in the same Journal Sir Oliver Lodge's views on energy (*138*, 229), it will be apropos to quote some views expressed by Sir J. J. Thomson who has spent a lifetime in study and experiment devoted to electronic phenomena. In his little book BEYOND THE ELECTRON, 1928, *i.e.*, the outerworld of the electron, on pages 12, 13 and 14 the following appears :— " To appreciate the importance of this [the duality of electrons and waves] we must consider for a moment how energy travels from one place to another. For example, when an electron changes its position its energy moves from the old position of the electron to the new : how does this energy travel? I may perhaps make the meaning of the question clearer if I take for a moment the old idea of the electron as a sphere 10^{-13} cm. in radius. When this moves does the energy travel, so to speak, as an inside passenger within the sphere, or is the energy located in the space outside the sphere, and so has to buffet its way through the ether when it moves from one place to another If, as I do, we believe with Faraday and Clerk Maxwell that the properties of charged bodies are due to lines of force which spread out from them into the surrounding ether, we must place the energy of the electron in the space outside the little sphere which is supposed to represent the electron. On this view all energy is in the ether and must travel from one place to another as waves through the ether. This transmission of energy through the ether instead of through the more obvious channels, was first put in a clear and precise form by my old friend Professor John Henry Poynting. His views lead to results which, though I believe them to be absolutely sound, are somewhat startling. For example, I suppose that most of you take for granted that the energy for the electric lamps flows from the power station to the lamps inside the copper wire which connects the one with the other. On Poynting's view this is not so, the energy does not travel inside the wire but keeps coming into the wire sideways from the space around it. The function of the wire is not so much to carry the energy inside as to guide the path of energy travelling outside. The energy travels as waves through the ether outside the wire at a speed which does not depend materially upon the size of the wire or the material of which it is made.

" It is generally recognised that the transmission of electrical energy is by waves through the ether : can we go further and say that energy of all kinds is transmitted in this way? It may quite well be that this is not really going further, for all energy may be of the same kind, located in the ether and having to travel through it. When we attempt to extend the wave transmission of energy from electrical to what seem other kinds of energy, we are met with what at first sight might seem an insuperable difficulty, which is this : All electrical waves, whatever their wave-length, travel with the same speed, that of light, through the ether, and the energy they carry must therefore travel with this speed. But when you or I move from one place to another and carry our energy with us, even the youngest of us are left sadly far behind by light. We must face the fact that energy may travel at any speed and to show that this is not inconsistent with its transmission through the ether. I think we can do this for though it is true that electrical waves long and short all travel through a structureless ether with the same velocity, yet, if the ether has mixed with it electrons or any bodies charged with electricity, the conditions are entirely changed. The charged bodies are set in motion by the electrical waves, and as a consequence emit electrical waves themselves; these secondary waves unite with the primary one, change its character, *e.g.*, alter its wave-length without altering its frequency and thus alter its velocity."

The problem bristles with difficulties. Consider the case of a continuous steady current. We do not ordinarily associate with it any waves, but there is the magnetic field round the conductor. This field can, however, be neutralised by making the return wire of the circuit a close companion to the other wire. The insulation between the wires might be strained and act as a recipient of energy, but so long as the current is steady it is difficult but not perhaps impossible to invoke the æther in the manner indicated by Sir J. J. Thomson. The central feature of the problem seems to lie in the interpretation of the words and terms used to describe the conditions as we believe we understand them. An illustration of quite a different phenomenon will perhaps put us on our guard here. Consider a New York skyscraper with thousands of tons of material in it. The word *tons* here implies the action of gravity yet people in the base-

ment of such a building have no knowledge, *i.e.*, experience no effect, of the enormous weight above them. There is no apparent strain except in the structural parts of the building. The space here referred to is neutral or neutralised so far as the people are concerned. Like gravity and many other phenomena it is a puzzle which has never been solved. I begin to suspect that the word *neutralised* means much more than a mere negation. These matters are elusive, and when a new road is opened up and all seems to be clear, lo and behold, a rock-like difficulty looms up in the distance before we have advanced very far in the new direction.

F. H. L.

GENERAL NOTES.

HUMBER OIL FROM COAL SCHEME.

SIR A. HAZLERIGG ON A "VENTURE OF NATIONAL IMPORTANCE.

ADMIRALTY CONCESSIONS.

Details of the scheme for the establishment of refineries on the banks of the Humber for the "cracking" of British coal oils and petroleum oils, were given by Sir Arthur Grey Hazlerigg, Bt., at the statutory meeting of Petroleum Refineries, Ltd., held in London on Thursday, May 23.

Sir Arthur Hazlerigg said that the site at Killingholme had been completely surveyed, the levels taken, and bores made. The concrete foundations, ditches, separators, etc., were now being made, and housing accommodation for the staff was nearly complete.

The site consisted of 33½ acres on the south side of the Humber adjoining the Admiralty Oil Storage Depot. On the site there was a concrete flat of 11½ acres on which to build the plant; a railway siding from the London and North Eastern Railway; three large tanks with a total capacity of 4½ million gallons complete with the necessary piping and pumps for loading and unloading; a large steel and concrete shed, 180 x 90 ft., which would contain the workshops, stores, laboratory and offices; a small bungalow dwelling, and a weigh-bridge. The presence of such valuable items had effected a considerable saving in time and money, and it was the opinion of American engineers who viewed the site that it was ideal.

"Our proximity to the Admiralty Oil Depot is particularly fortunate," continued Sir Arthur, "they have been very helpful and have agreed to grant the company a 21-year agreement for the use of their pier to enable us to unload our incoming cargoes of crude oil. They have agreed to build an extension to their pier to carry our piping, and this is now being done. Our position on the Humber will enable us to send our products by barge, the cheapest form of transport, to the considerable markets of the Midlands. We already have our own jetty for loading these barges, and from there they can proceed to places in the North and Midlands, which will be sub-distributing stations. We have acquired an option on a site on the Trent at Nottingham on favourable terms where we propose to put up a sub-storage station, and it is our intention to acquire similar sites in advantageous positions."

"We must bear in mind," he concluded, "that we have here a venture of great national importance. The Low Temperature Carbonisation Co., Ltd., has a process that produces smokeless fuel and oil; Petroleum Refineries, Ltd., has a process that converts the oil produced by low temperature carbonisation into petrol and other by-products. Together they offer a helping hand to that most vital and important national industry —coal."

INTERATIONAL RAYON STATISTICS.

Writing in a recent issue of the *Rayon Record*, a contributor says:—

The many anomalies in foreign trade statistics relating to exports of cloth wholly or partly made from rayon yarn diminish the value of comparisons between the movements of yard and of cloth. Only Great Britain publishes figures which give any clue to the quantity of rayon contained in exports of mixed fabrics. Many countries include rayon mixtures with silk and other mixtures, and so do not record them separately from yarn. It seems reasonable to conclude, however, from such data as are available that the trade in rayon yarn at present largely exceeds the trade in cloth, whether pure or mixed with other textiles. So far as international trade is concerned rayon is, therefore, principally a raw material for the weaving and knitting industries. There appears to be comparatively little re-export, either of yarn, or of imported yarn that has been turned into cloth.

Our present information with regard to the International movement of the newest textile material is lamentably deficient. Unfortunately there is no obvious or immediate

remedy. In course of time it may be expected that the Governments concerned will amend their statistical knowledge of the trend of business between countries. In doing so, it is to be hoped that they will devote some thought to the differentiation of qualities, so that in addition to total weight and value, some light may be thrown upon the relative progress of fine and coarse deniers, and development of rayon fabrics.

On the other hand, the data are probably adequate for the purpose of showing the importance of the export trade in rayon, which is relatively larger than either the cotton yarn or piece goods export trade. The actual quantity exported is, of course, comparatively insignificant, as against cotton, but it is noteworthy that exports form so large a proportion as 30 per cent. of production, in spite of the inducements to establish a new unit of production wherever the market is big enough."

NEW F.B.I. HEADQUARTERS.

Building Started in Westminster.

The contract has now been signed for the erection of the new F.B.I. building on a site in Tothill Street, Westminster, upon which work will begin at once.

The building will be entirely built by its future owners—in other words, al lthe firms engaged in the manufacture of materials for the construction of the building are members of the F.B.I., from Messrs. J. Laing, the contractors, down to the firm supplying the smallest article.

The building will, when finished, be a worthy addition to London's great public buildings and will have a frontage of 90 ft. and a height to the roof of 90 ft. The architects, Messrs. Coleridge, Jennings & Soimenow, have had several difficulties to contend with, the chief being to fit modern requirements of light, air and comfort into the traditional lines and proportions of the best period of early Georgian architecture. Moreover, to bring the building into conformity with modern requirements it was necessary to provide a big opening on the ground floor for shops without creating the impression of a modern house standing stilt-legged on piles.

Messrs. Coleridge, Jennings and Soimehow have succeeded admirably in their work and have contrived a very handsome building by combining the use of hrick with Portland stone and using every available inch of ground without any sacrifice of light. It has, of course, been designed to meet the special requirements of a body such as the Federation of British Industries, but at the same time to be a sound commercial proposition. To minimise the noise from street traffic, the large hall for the Federation's Council, the various committee rooms and the directors' offices will be on the top floor. The Assembly Room has dimensions of 50 feet by 30 feet, and is designed to seat 210 people comfortably.

The building incorporates an entirely new system of central heating by low pressure steam, combining the advantages of both steam and water, and has two lifts which rise at a speed of no less than 300 feet a minute.

JAMES YOUNG MEMORIAL.

A memorial has been organised to commemorate the life and work of Dr. James Young, the Glasgow scientist, who in 1850 took out the first patent for the low temperature distillation of coal, and so became the Father of an industry now regarded as of prime importance in the resuscitation of the British coalfields.

Amongst the distinguished supporters of the scheme are Sir Ernest Rutherford, President of the Royal Society; Sir Sobert Irvine, Vice-Chancellor of St. Andrew's University; Captain Walter Elliot, M.C., Under-Secretary of State for Scotland; Sir David Mason, Lord Provost of Glasgow; Lord Scone; Sir Herbert Matthews; Colonel S. Heckstall-Smith; and Mr. James Young, a direct descendant of Dr. Young.

The memorial, which will take the form of a plaque, is to be erected at Glenboig, near Glasgow—a few miles from Dr. Young's original plant of over 70 years ago—at the largest low temperature coal distillation plant in the world now being constructed for the Bussey Company. An nnveiling ceremony is being planned for mid-June.

Dr. Young, who was born at Drygate in 1811, was the son of a joiner. He received scanty education at night schools, working at the bench with his father during the day. While attending evening classes, he met David Livingstone, with whom he formed a lifelong friendship. His scientific discoveries were many, quite apart from low temperature coal distillation research work. They included a method of making sodium stannate direct from tin-stone and a process for preventing the rusting of iron ships, which was afterwards adopted by the Navy.

In 1878 he was elected a Fellow of the Royal Society and was vice-president of the Chemical Society in 1878. St. Andrew's

University later conferred on him the degree of LL.D.. He endowed a Young chair of technical chemistry at Anderson's College, now incorporated with the Glasgow and West of Scotland Technical College.

WREATH ON SIR HUMPHRY DAVY'S TOMB.

A delegation of professors of the Faculty of Science of Geneva University deposited a wreath on the tomb of Sir Humphry Davy, who died in Geneva on May 9, 1829. He was buried in the Plainpalais cemetery, where the town granted a free burial place for 99 years. The concession was renewed some years ago by the Royal Society until 1965. Lady Davy expressed her gratitude in a letter which is preserved at Geneva University, and presented the University with a sum which has made it possible ever since to award the so-called Davy prize every year for the fest study by students of the University in physics, chemistry, mineralogy, botany, or geology.

UNITED STATES DEPARTMENT OF AGRICULTURE.

Food, Drug, and Insecticide Administration.

CERTIFICATION OF COAL-TAR FOOD COLOURS.

The Permitted Dyes.

Two new colours,Ponceau SX and Sunset Yellow FCF, are now added to the list of coal-tar dyes accepted for certification by the department. The following coal-tar dyes are now accepted for certification as described on pages 4 to 6 of Service and Regulatory Announcements, Food and Drug No. 3:

Red Shades—80 Ponceau 3R; 184 Amaranth; 773 Erythrosine; Ponceau SX.

Orange Shade—750 Orange I.

Yellow Shades — 10 Naphthol Yellow S; 640 Tartrazine; 22 Yellow AB; 61 Yellow OB; Sunset Yellow FCF.

Green Shades—666Guinea Green B; 670 Light Green SF Yellowish; Fast Green FCF.

Blue Shade—1180 Indigotine.

The numbers preceding the names refer to the colours as listed in the Colour Index published in 1924 by the Society of Dyers and Colourists of England, which gives the composition of these dyes. Names not preceded by numbers are not listed in the Colour Index. The composition of such dyes will be furnished on application to the Food, Drug, and Insecticide Administration.

In *Chemisch Weekblad* (May 25, p. 298) Prof. I. M. Kolthoff describes a direct method for the titration of potassium ferrocyanide solutions with zinc sulphate using diphenylamine as an internal indicator. A procedure has also been worked out to eliminate the effect of interfering substances.

CHEMICALS FROM TREE-STUMPS.

Net profits of $355,930 (£71,186) for the first quarter of 1929 are reported by the Newport Company, the big U.S. chemical manufacturing firm which specialises in the conversion of tree-stumps and other waste woods into chemicals. Net sales for the quarter amounted to $2,591,106 (£518,221) compared with $7,494,000 (£1,498,800) for the whole of 1928. The regular quarterly dividend of 75 cents per share has been declared on the convertible Class A stock of the company.

Rapid strides have been made by the Newport Company and its subsidiaries, financed by Dillon Read & Co., of New York, since its recent acquisition of fresh working capital through a stock issue of $6,500,000 (£1,300,000) which was made for it by Dillon Read & Co. The Company has now no funded debt, and is embarking on a number of new and profitable activities. These include the manufacture of artificial cork from spent wood fibre.

The Company is a large producer of dyestuffs as well as of heavy chemicals required in the manufacture of paints, paper, ink, leather and numerous textiles.

1,500,000 TONS COAL CONTRACT.

BRITAIN'S PROGRESS IN LOW TEMPERATURE CARBONISATION.

OPTION GRANTED TO AMERICA.

Remarkable progress in coal carbonisation in Great Britain during the past few months is revealed by an interim report just issued to the shareholders of Low Temperature Carbonisation, Ltd.

It is stated that new works at Askern, having a capacity of nearly 4,000 tons per week, will be in 50 per cent. operation in May and a favourable contract has been made for the supply to Doncaster Coalite, Ltd., the subsidiary company owning the works, of approximately 1,500,000 tons of best washed coal direct from the colliery to the retorts without transport charges.

The petrol recovery plant at the parent works at Barugh, Yorkshire, has been replaced by a larger and modern plant, by

means of which the output of petrol has been more than doubled and the quality improved.

Arrangements for the coalite works to be erected at West Greenwich for the South Metropolitan as Company are well in hand, and it is hoped to complete the plant in time for next Winter's trade. A ready sale, says the report, is assured for all the somekeless fuels that can be produced by this plant.

SOUTH AUSTRALIAN TRADE.

According to the South Australian Government Statist, exports during the seven months ended 31 January, 1929, exceeded imports by £1,541,363, the former being valued at £8,256,879 and the latter at £6,715,516. The chief imports were textiles (piece-goods, etc.), £930,434; machines and machinery, £845,803; motor and other vehicles, £767,410; oils in bulk (petrol, kerosene, etc.), £584,040; bags, sacks, etc., £501,696; sundry metal manufactures, £384,755; and iron and steel, £356,398.

As regards exports the principal items were: wool, £2,336,836; wheat, £1,496,104, lead (pig and in matte), £1,232,831; concentrates (silver, etc.), £747,087; silver (bullion), £541,922; flour, £489,328; and skins and hides, £456,465.

The requirements of motor transport necessitated the importation of 14,533,003 gallons of petroleum spirit, as compared with 12,381,202 gallons in the seven months ended 31 January, 1928.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Papers read on Thursday, May 30 :—

The Energy Functions of the H_2 Molecules. By O. W. RICHARDSON, F.R.S., AND P. M. DAVIDSON.

Infra-Red Investigations of Molecular Structure. Parts I and II. By E. K. RIDEAL, C. P. SNOW, F. I. G. RAWLINS AND A. M. TAYLOR.

The Connection Between the Zig-Zag Structure of the Hydrocarbon Chain and the Alternations in the Properties of Odd and Even Numbered Chain Compounds. By A. MULLER. Communicated by Sir William Bragg F.R.S.

It is shown that the alternations in the physical properties of the odd and even numbered chain compounds are closely related to the peculiar structure of the hydrocarbon chain. Starting from the fact that the CH_2-groups are arranged in a zig-zag line, it is shown that there must exist an essential difference in the structure of the odd and even numbered substances. This differeuce accounts for the alternations.

Papers read in title only :—

The Emission of Soft X-rays by Different Elements at Higher Voltages. By O. W. RICHARDSON, F.R.S., AND F. S. ROBERTSON.

The Soft X-ray Emission from Various Elements after Oxidation. By L. P. DAVIES. Communicated by O. W. Richardson, F.R.S.

The effect of oxidation on the total soft X-ray emission from the following elements has been studied : Silicon, manganese, iron, cobalt, nickel, copper, molybdenum, palladium and tungsten. The efficiencies are levelled up after oxidation, and this suggests that the efficiency of the oxide is the average efficiency of the oxygen and element present. On this assumption, the efficiency for oxygen is calculated and its mean value is at 600 volts, 3.61×10^{-6}; at 500 volts, 3.15×10^{-6}; at 400 volts, 2.82×10^{-6}; at 300 volts, 2.06×10^{-6}.

A Study of the Catalysis by Silver of the Union of Hydrogen and Oxygen. By D. L. CHAPMAN F.R.S., AND W. K. HALL.

The new method of Hughes and Bevan to investigate catalysis by nickel of the union of hydrogen and oxygen has been used by the autbors to study catalysis by silver of the same reaction. Conclusions drawn from the results thereby obtained have been confirmed by direct measurements of the falls of pressure which occur when the gases, separately aud mixed together, are brought into contact with a large surface of silver.

The authors have come to the following conclusions :—

1. When a surface of metallic silver is brought into contact with gaseous oxygen, in sufficieut quantity to form more than a complete unimolecular layer of oxide, at temperature of laboratory, it becomes coated with a film of silver oxide, and very little, if any, of the surface is left unoxidised.

2. When metallic silver is heated to redness in oxygen and allowed to cool in the gas a film of oxide is also formed at the surface.

3. The film of oxide formed at a low temperature catalyses the combination of hydrogen and oxygen much more readily than the film formed at a high temperature, and is also more easily reducible by hydrogen.

4. The mechanism of catalysis of union of hydrogen and oxygen by the film is one of alternate reduction and re-oxidation of the film.

To account for difference of behaviour of the two classes of oxide films the working hypothesis is adopted that in the active film, formed at a low temperature, some of the molecules of silver oxide are in relatively unstable positions, but that on raising the temperature the arrangement of these molecules becomes more stable and the film in consequence less chemically active.

A Detailed Study of the "Radio-Active Decay" of, and the Penetration of α-Particles into a Simplified One-Dimensional Nucleus. By R. H. Fowler, F.R.S., and A. H. Wilson.

The authors in this note solve exactly for a simplified nucleus the problem of α-particle disintegration (determination of the *complex* characteristics of the wave-equation with the proper boundary conditions). They then proceed to discuss the converse problem of the penetration of an α-particle into the nucleus from without—a problem which is the basis of Gamow's theory of *artificial* disintegration. They find that the problem formally depends very much on whether the energy of the incident α-jarticle is or is not equal to the real part of a characteristic of the nucleus bombarded. They show that this type of penetration has features characteristic of a resonance effect as one should expect, and finally, that our solutions are not of *practical* importance as they do not correspond to the conditions of any conceivable experiment. Further progress has been made in a forthcoming paper by Gamow and Houtermans.

Gaseous Combustion in Electric Discharge. Part III. By G. I. Finch and D. L. Hodge. Communicated by W. A. Bone, F.R.S.

The combustion of dry "detonating gas" within the cathodic region of a direct current discharge has been examined. Such combustion is proportional to the current and practically independent of the pressure, but depends upon the nature of the cathode material. Combustion at cathodes consisting of freely sputtering metals is far more vigorous than at poorly or non-sputtering metals. Thus, at silver, gold, platinum and palladium c/i (the ratio of rate of combustion to current) is relatively high, varying between 0.28 and 0.29. At magnesium, aluminium, copper, tungsten or tantalum cathodes, however, c/i lies between 0.045 and 0.10.

It is concluded that (i) the combustion of dry detonating gas in the direct current discharge is primarily determined by the ionisation of both the constituent molecules of the gas; (ii) electrostatic forces of repulsion keep apart and prevent combination of positively charged ions, unless such forces are counteracted by some other force or agency producing an opposite effect; (iii) one such agency is negatively charged metal atoms sputtered from the cathode which, by forming electrically neutral metal-gas complexes with positive ions, overcome electrostatic repulsion and thus enable combustion to proceed.

The Electrical Condition of Hot Surfaces During the Adsorption of Gases. Part III. By G. I. Finch and J. C. Stimson. Communicated by W. A. Bone, F.R.S.

An X-ray Investigation of the Structure of Naphthalene and Anthracene. By J. M. Robertson. Communicated by Sir William Bragg, F.R.S.

The crystal structures of naphthalene and anthracene have been examined in detail by the rotating crystal photographic method. General and statistical considerations of the reflections indicate a periodic structure parallel to the c axes of the crystals. The assumption is then made that the scattering centres (each regarded as consisting of a carbon atom and its attendant hydrogen atom if any) lie on two uniform rows parallel to the c axes of the crystals, thus forming a chain-like structure. With this limitation of the parameters it is possible to develop compact geometrical structure factors, which give an approximate account of the principal intensity variations in the various spectra of naphthalene and anthracene when the parameters are given certain values. The dimensions of the molecules of naphthalene and anthracene calculated from these values are shown to differ only slightly from those of Bragg's tetrahedral structure. The chain structure is further shown to be very closely similar in many of its dimensions to the chain structure of the hydrocarbon $C_{29}H^{6}{}_{0}$ as determined by Müller. Evidence is thus afforded that the tetrahedral properties of the carbon atom are maintained in aromatic structures.

The Arc Spectrum of Chlorine. By K. Majumdar. Communicated by M. N. Saha, F.R.S.

The Arc Spectrum of Germanium. By K. Rao. Communicated by A. Fowler, F.R.S.

Observations of the arc spectrum of germanium have been extended to λ 1690 and

about fifty new lines have been aded, most of which have been classified.

On the Emission of Soft X-rays by Different Elements, with Reference to the Effect of Adsorbed Gas. By U. NAKAYA. Commnnicated by O. W. Richardson, F.R.S.

Effects of adsorbed gas molecules on the photo-electric plate and target upon the excitation and absorption of soft X-rays were examined. The absorption of these rays was found to increase with the amount of the adsorbed gas molecules on the photo-electric plate, while the excitation decreased with the presence of gas molecules.

The Scattering of Fast Electrons by Atomic Nuclei. By N. F. MOTT. Communicated by N. Bohr, F.M.R.S.

The scattering of electrons by an atomic nucleus is investigated, using the wave equation of Dirac. A scattering formula is obtained, which gives the spin-relativity correction to be applied, for fast β-particles, to the usual Rutherford formula. It is also shown that if the initial stream of electrons is unpolarised, the spin axes pointing in all directions at random, then the scattered beam is partially polarised. It is shown how this polarisation could be observed experimentally by a second scattering experiment.

Further Investigations of the Spectrum of Ionised Nitrogen (N.II). By L. J. FREEMAN. Communicated by A. Fowler, F.R.S.

In further investigating the spectrum of ionised nitrogen, nine terms belonging to a quintet system have been identified and two new terms of the triplet system. Some 75 lines have been newly classified.

The Absorption Spectra of Halogens and Inter-Halogen Compaunds in Solution in Carbon Tetrachloride. By A. E. GILLAM AND R. A. MORTON. Communicated by E. C. C. Baly, F.R.S.

On the Criteria for the Stability of Small Motions. By R. A. FRAZER AND A. J. DUNCAN. Communicated by H. Lamb, F.R.S.

On the Numerical Solution of Equations with Complex Roots. By R. A. FRAZER AND W. J. DUNCAN. Communicated by H. Lamb, F.R.S.

On Einstein's United Field Theory. By G. C. MCVITIE. Communicated by A. S. Eddington, F.R.S.

NOTICES OF BOOKS.

The Pyrolysis of Carbon Compounds. By CHARLES D. HURD. Pp. 807. New York: Chemical Catalog Co. 1929. Price $12.50.

The latest volume of the American Chemical Society Monographs published by the Chemical Catalog Co., is one of the largest and by no means the least important. Fire has been one of the most extensively employed processes in aid of chemical transformations since the earliest times. The author has kept in view in compiling the present very comprehensive account of the varions types of pyrolytic reactions, the need for making as complete a survey as possible and has indeed incorporated matter hitherto unpublished. He has also placed a judicious emphasis upon the main trends of the subject.

In his discussion of thermal decomposition, Prof. Hurd has not attempted to include a complete account of catalysis although the function of individual catalysts in heat decompositions is adequately discussed.

Attention has been paid to the nature of the vessels in which pyrolysis is carried out and it would seem that here is a new field for apparatus and plant constructed of stainless steel.

The compounds subjected to pyrolysis cover the whole field of organic chemistry and the commercial substances (coal, wood, etc.), which it might be supposed would occupy a large share in such a treatise as this are dismissed in short chapters.

The more recently developed organic chemicals of industrial importance, *e.g.*, hydrocarbons, receive very adequate treatment. The volume can therefore be recommended to all organic, industrial and general chemists who desire to know the trend of progress in the field of pyrolysis.

Physikalische Chemie der Silikate. By DR. W. EITEL. Leipzig: Leopold Voss. Pp. xii + 514. 1929. Price 60 marks.

This comprehensive treatise on the silicates is characterised by German thoroughness and completeness, for Dr. Eitel has covered the whole subject from the physico-chemical standpoint. There has been much done in recent years with the object of elucidating the exact nature of the combinations of metallic oxides and silica in order to facilitate improvements in the numerous silicate industry. The most fruitful line of advance has been the investigation of the ternary and quarternary systems in such cases as SiO_2-Al_2O_3-CaO and these with Na_2O—a field in which Dr. Eitel himself has made valuable contributions. The author has reviewed the whole subject and stresses the physical-chemistry viewpoint, especially in connection with the study of the equilibria of binary and ternary systems.

The latest results have been incorporated in the present volume which will become the standard reference work on the subject.

Anorganische und Organische Entfärbungsmittel. By DR. LEOPOLD SINGER. Pp. viii + 251. Price Rm. 20. (Band XX d. Sammlung "Technische Fortschrittsberichte," herausgegeben von Professor Dr. B. Rassow.) Dresden and Leipzig : Theodor Steinkopff. 1929.

Bei der wachsenden Bedeutung der technischen Verwendung anorganischer und organischer Entfärbungs- und Bleichmittel in der chemischen Industrie, insbesondere der Erdölverarbeitung und Zuckerindustrie, der Entfärbung vegetabilischer, animalischer und mineralischer Ole, Fette, Wachse und sonstiger Stoffe, fehlte es bisher an einer modernen, zusammenfassenden Darstel lung. Hier will das vorliegende Buch helfen. —Gestützt auf ein umfangreiches Quellenmaterial und eine fast 40 jährige Praxis bietet der Verfasser in seinem Buche einen umfassenden Uberblick über die grosen Errungenschaften, die etwa in den letzten 15 Jahren gemacht worden sind.—Man denke nur an die enorme Entwichlung der physikalisch-chemischen und kolloidchemischen Reinigungsmethoden.

Besondered Wert ist auf eine möglichst vollständige Berücksichtigung der Patentliteratur des In- und Auslandes gelegt worden. Bei der Fülle des Inhaltes und der vorzüglichen Behandlung des Stoffes ist das Buch ein unentbehrliches Orientierungsmittel für jeden Fabrikanten und Verbraucher.

PUBLICATIONS RECEIVED.

U.S. BUREAU OF STANDARDS.

A New Determination of the Melting Point of Palladium. By C. O. FAIRCHILD, W. H. HOOVER, AND M. F. PETERS. Research Paper 65. Price 10 cents.

Thermal Expansion of Tantalum. By P. HIDNERT. Research Paper 62. Price 5 cents.

Origins of Place Names (Second Series). MIV. *Memory.* By AN IGNORANT STUDENT. Pp. 13. Printed privately at the Chiswick Press. 1928. Price 1s.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, June 26, at 4 p.m.—Annual General Meeting.

MINERALOGICAL SOCIETY.

Tuesday, June 11, at 5.30 p.m.—General Meeting. The following papers will be read :

"The Meteoric Stone of Lake Brown, Western Australia." By Dr. G. T. Prior.

"Bismutatantalite, a New Mineral from Uganda." By E. J. Wayland.

"On a Partially Fused Quartz-Felspar-Rock and on Glomero-Granular Texture." By Dr. L. Hawkes.

"The Occurrence of a Mineral Hitherto Unrecognised in the Phonolites of Dunedin, New Zealand." By Dr. F. Marshall.

"Füloppite, a New Hungarian Mineral of the Plagionite-Semseyite Group, exhibited by Dr. L. J. Spencer on behalf of I. de Finály and Dr. Sándor Koch.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

15,536.—Cosway, H. C.—Concentration of aqueous acetic, etc., acid.

14,989.—Gardner, E. H.—Removal of hydrogen sulphide from aid. May 14.

15,257.—Imperial Chemical Industries, Ltd.—Methods of absorbing hydrogen cyanide from gases. May 16.

15,536, 15,537.—Imperial Chemical Industries, Ltd.—Concentration of aqueous acetic acid, etc. May 17.

15,538.—Imperial Chemical Industries, Ltd.—Separating aluminium chloride from other chlorides. May 17.

Specifications Published.

284,998.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 2 : 3-aminonaphthoic acid.

288,985.—Imray, O. Y. (I. G. Farbenindustrie. Akt.-Ges.) — Manufacture of benzanthrone - peri - dicarboxylic acid or its derivatives or substitution products.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

308,859.—Ethyl alcohol.—Slade, R. E., Norton Hall, The Green, Norton-on-

Tees, and Imperial Chemical Industries, Ltd., 50, Broadway, Westminster.

Ethyl alcohol is prepared by treating ethylene with steam at an elevated temperature and pressure in the presence of a dehydrating catalyst. Preferably, a mixture of ethylene and steam containing a considerable excess of ethylene is passed at 400-500° C. at a pressure of 25-200 atmospheres with a relatively high space velocity over a dehydrating catalyst such as thoria, or phosphoric acid deposited on charcoal. The process may be effected continuously, the reaction products being cooled to condense ethyl alcohol and water vapours and the excess ethylene being conducted in heat-exchange with the reaction products and then returned to the reaction chamber, to which additional amounts of ethylene and steam are supplied, as required. Ethylene diluted with other gases such as hydrogen or nitrogen, or ethylene concentrates prepared as described in Specification 291,186 may be used, the circulating gases being continuously or periodically purged in order to maintain a sufficiently high concentration of ethylene.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

REGENSEL.

501,813.—Chemical substances used in manufactures.—The Salt Union, Ltd., Colonial House, Water Street, Liverpool. May 22.

STOKALIN.

499,290—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — Battle, Hayward & Bower, Victoria Chemical Works, Newark Road, Lincoln. May 22.

MIXALB.

501,597.—Chemical substances prepared for use in medicine and pharmacy.—Frank Lancelot Saunders, 255, Kingsland Road, London, E.2. May 22.

"CHEMICAL NEWS"—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 82 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, "CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.
Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

URGENTLY WANTED

TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.
also
No. 3400. Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3609.

Merton House, Salisbury Square,
London, E.C.4.

Telephones:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. Page.

The Collinsics of Minerals. XII. 369
By Hawksworth Collins, B.A.
The Helicoidal Classification of the Elements 372
By Charles Janet.
An Analysis of the Arc and Spark Spectra of Yttrium 375
By William F. Meggers and Henry Norris Russell.
The Magic of Coal............ 375
By Dr. M. A. Matthews.
The Industrial Fellowships of the Mellon Institute, 1928-29. 376
General Notes 377
Proceedings & Notices of Societies :—
The Royal Society 377
The Chemical Society 378
The Optical Society 379
Geological Society 379
The Chemical Society of Japan ... 380
The Institute of Chemistry of Great Britain and Ireland 380
Royal Institution 381
Notices of Books 381
Forthcoming Events 382
New Patents 383
New Trade Marks 384

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 to 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

THE COLLINSICS OF MINERALS. XII.

By Hawksworth Collins, B.A. (Camb.).

Twelve more collinsics are here presented to scientists. Ten of them contain the element boron (the only new introduction) of which the relative volume is 3.865 and the optical refractivity is also 3.865. This is the third instance in which the R.V. of an element is exactly the same as its O.R.; and there are many to come.

There is no hypothesis nor is there any speculation in these results, but they are clearly mathematical discoveries upon the experimental figures obtained by many scientists.

In each collinsic there are as many double-constants as there are atoms in each molecule. These double-constants will be called "Voloptics" for the future. The voloptics which have been employed so far in the first 144 collinsics are given in Table XVI together with the number of times each one has occurred.

Table XVI.
The Voloptics of the First 144 Collinsics.

	Relative Volume	Optical Refrac-tivity	No. of times the pair has occurred in the first 144 Collinsics
Na	11.865	3.865	59
K	22.29	7.49	13
N	3.8	3.8	4
Ca	14.54	10.52	61
Ca	13.25	13.25	22
Si	13.02	11.53	62
Si	13.83	9.78	32
Si	17.61	9.625	53
Si	18.91	10.461	43
P	14.56	10.51	44
Cu	7.13	13.22	37
Cu	9.54	14.77	24
Cl	15.085	10.82	7
O	7.53	1.654	204
O	4.45	1.747	165
O	2.51	1.364	1120
H	5.76	2.613	728
F	5.42	0.26	22
Al	9.05	7.865	107
Al	12.05	4.863	32
Mg	8.71	6.0015	48
Mg	7.51	5.031	17
C	8	3.333	13
S	15.53	5.75	13
Be	4.62	3.733	17
As	19.58	17.75	20

Besides this, each collinsic has three pairs of corresponding values :—

1. The theoretical S.G. of the substance, obtained by dividing the molecular weight by the sum of the relative volumes of the component atoms (given between the brackets in the third line) must be within one per cent. of the experimental S.G. given *at the end of the second line.*

2. The sum of these volumes, when multiplied by $\mu - 1$ (where μ is the refractive index of the substance) must give a number which corresponds to at least four figures with the sum of the optical refractivities of the elements of the molecule.

(3) The theoretical refractive index must agree with the experimental within one per cent.

These three corresponding values, which are peculiar to each substance, will be terms " Coils " for the future. This word may be supposed to be an abbreviation of some such word as " collineated."

It will be easier for one to follow these matters by taking an example. In No. 135, Jeremejevite, there are five voloptics, of which three happen to be the same, so that there are really only three to be considered.

(A) Whenever the R.V. of an atom of aluminium is 9.05, its O.R. is 7.865 in all minerals.

(B) Whenever the R.V. of an atom of boron is 3.865, its O.R. is always 3.865 in all minerals.

(C) Whenever the R.V. of an atom of oxygen is 4.45, its O.R. is always 1.747 in all minerals.

The three colls in this mineral are—

(a) The theoretical S.G. 3.274 which is easily within one per cent. of the experimental S.G. 3.28.

(b) The theoretical R.I. 1.6462 which is easily within one per cent. of the experimental R.I. 1.64.

(c) The product 16.972 (obtained by multiplying the sum of the atomic volumes by $\mu - 1$) is correct to four figures with the sum of the O.R.'s of the elements of the molecule (16.971).

TABLE XVII.

THE COLLINSICS OF TWELVE MINERALS.

(133)	Colemanite	$H + Ca + B_3 + O_6 + 2H_2O$	**2.413**	2.417	D
		$51.082 = 0.5984(5.76 + 13.25 + 3.865_3 + 4.45_6 + 14.03_2)$	**1.5984**	1.59202	D
				1.61398	D
		$51.084 = 2.613 + 13.25 + 3.865_3 + 1.747_6 + 6.572_2$			
(134)	Dumortierite	$Al_8 + B + Si_3 + H + O_3 + O_4 + O_{13}$	**3.26**	3.26	M
		$133.43 = 0.6874(9.05_8 + 3.865 + 13.02_3 + 5.76 + 7.53_3 + 4.45_4 + 2.51_{13})$	**1.6874**	1.678	S
			...	1.689	S
		$133.436 = 7.865_8 + 3.865 + 11.53_3 + 2.613 + 1.654_2 + 1.747_4 + 1.346_{13}$			
(135)	Jeremejevite	$Al + B + O_3$	**3.274**	3.28	D
		$16.972 = 0.6462(9.05 + 3.865 + 4.45_3)$	**1.6462**	1.64	D
		$16.971 = 7.865 + 3.865 + 1.747_3$			
(136)	Danburite	$Ca + B_2 + Si_2 + O_3 + O_5$	**2.95**	2.97	D
		$53.007 = 0.6352(14.54 + 3.865_2 + 13.02_2 + 7.53_3 + 2.51_5)$	**1.6352**	1.6342	D
				1.6363	D
		$53.002 = 10.52 + 3.865_2 + 11.53_2 + 1.654_3 + 1.346_5$			
(137)	Datolite	$H + Ca + B + Si + O + O_4$	**2.92**	2.983	D
				2.898	D
		$35.563 = 0.6495(5.76 + 14.54 + 3.865 + 13.02 + 7.53 + 2.51_4)$	**1.6495**	1.6474	D
				1.6527	D
		$35.566 = 2.613 + 10.52 + 3.865 + 11.53 + 1.654 + 1.346_4$			

(138) Ascharite $Mg_2 + B_2 + O + O_3 + O + H_2O$

2.685 2.69 W

$\mathbf{34.546 = 0.55212(8.71_2 + 3.865_2 + 7.53 + 4.45_3 + 2.51 + 14.03)}$

1.55212 N_m1.55
N_p1.53 W

$\mathbf{34.546 = 6.0015_2 + 3.865_2 + 1.654 + 1.747_3 + 1.346 + 6.572}$

(139) Meyerhofferite

$Ca_2 + B_6 + O_6 + O_3 + O_2 + 7H_2O$

2.1187 2.12 W

$\mathbf{113.55 = 0.537(13.25_2 + 3.865_6 + 7.53_6 + 4.45_3 + 2.51_2 + 14.03_7)}$

1.537 N_m1.535 W

$\mathbf{113.551 = 13.25_2 + 3.865_6 + 1.654_6 + 1.747_3 + 1.346_2 + 6.572_7}$

(140) Searlesite $Na + B + Si_2 + O_6 + H_2O$

2.468 2.45 W

$\mathbf{43.303 = 0.524(11.865 + 3.865 + 18.91_2 + 2.51_6 + 14.03)}$

1.524 N_g1.528 W
N_p1.520 W

$\mathbf{43.300 = 3.865 + 3.865 + 10.461_2 + 1.346_6 + 6.572}$

(141) Tourmaline (Dravite)

$H_5 + Na + Mg_4 + Al_8 + B_4 + Si_8 + O_4 + O_6 + O_{31}$

3.1 2.9-3.2 W

$\mathbf{256.38 = 0.6274(5.76_5 + 11.865 + 8.71_4 + 9.05_8 + 3.865_4 + 13.83_8 + 7.53_4 + 4.45_6 + 2.51_{31})}$

1.6274 N_o1.635 W
N_e1.6144 W

$\mathbf{256.38 = 2.613_5 + 3.865 + 6.0015_4 + 7.865_8 + 3.865_4 + 9.78_8 + 1.654_4 + 1.747_6 + 1.346_{31}}$

(142) Howlite $H_5 + Ca_2 + Si + B_5 + O_6 + O_8$

2.564 2.58 W
2.55 D

$\mathbf{91.116 = 0.5959(5.76_5 + 13.25_2 + 13.02 + 3.865_5 + 7.53_6 + 2.51_8)}$

1.5959 N_m1.598 W

$\mathbf{91.112 = 2.613_5 + 13.25_2 + 11.53 + 3.865_5 + 1.654_6 + 1.346_8}$

(143) Riversidite $Ca_2 + Si_2 + O_6 + H_2O$

2.604 2.61 W

$\mathbf{46.615\ \ 56.615 = 0.5898(14.54_2 + 18.91_2 + 2.51_6 + 14.03)}$

1.5898 1.595 N_p W

$\mathbf{56.61 = 10.52_2 + 10.461_2 + 1.346_6 + 6.572}$

(144) Indianaite $Al_2 + Si_2 + O + O_6 + 3H_2O$

2.404 2.31-2.53 D

$\mathbf{62.232 = 0.542(12.05_2 + 13.02_2 + 7.53 + 2.51_6 + 14.03_3)}$

1.542 1.538 W

$\mathbf{62.232 = 4.863_2 + 11.53_2 + 1.654 + 1.346_6 + 6.572_3}$

52 additional minerals, containing only the above voloptics, could be given at this point; but, as it is necessary to get on with the demonstration regarding other elements, they must be omitted for the present

The thick type denotes the discovery. The ordinary type gives the experimental data of other scientists, which led to it.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

APPLICATION FOR LICENCES IN MAY, 1929.

The total number of applications received during the month was 687, of which 612 were from merchants or importers. To these should be added 12 cases outstanding on the 30 April, making a total for the month of 649.

THE HELICOIDAL CLASSIFICATION OF THE ELEMENTS.

By Charles Janet.

[Ever since J. A. R. Newland's first paper on the "Law of Octaves" appeared in the *Chemical News* (1865, xii, 83) many contributors to this Journal have suggested schemes to indicate the periodicity of the elements. A number of the recent ones were summarised by Dr. J. G. F. Druce in the *Chemical News*, 1925, cxxx, 322, and in addition there have been a number of papers by F. H. Loring. The latter has published (*Chemical News*, 1909, xcix, 148) a method of harmonising the Atomic Weights and other properties of the Elements and (in 1922) a Wedge Periodic Table. Mr. Loring has summarised his views in his work, *The Chemical Elements* (Methuen, 8s. 6d.), which may have escaped the attention of M. Janet.—Ed., C.N.]

In this article it is proposed to construct a scalariform, helicoidal Table of the Classification of the Chemical Elements to show the various categories of the systematic groupings of the elements in accordance with Moseley's Law by arranging the elements in order, spirally, round a cylinder.

This method of classification is characterised by an extremely regular arithmetical sequence and fits in with Bohr's views of the atom. It establishes a rule for the increase of atomic weight which progresses according to definite rules. The classification is also in harmony with the periodicity of physical constants. It accounts well for the position of the metalloids. It also indicates the gradual evolution of the elements from protons and electrons into their atomic structure.

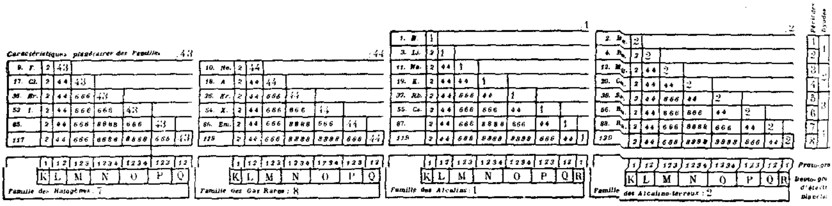


Fig. 1.

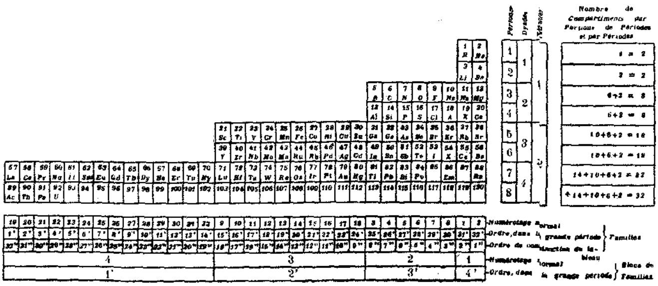


Fig. III.

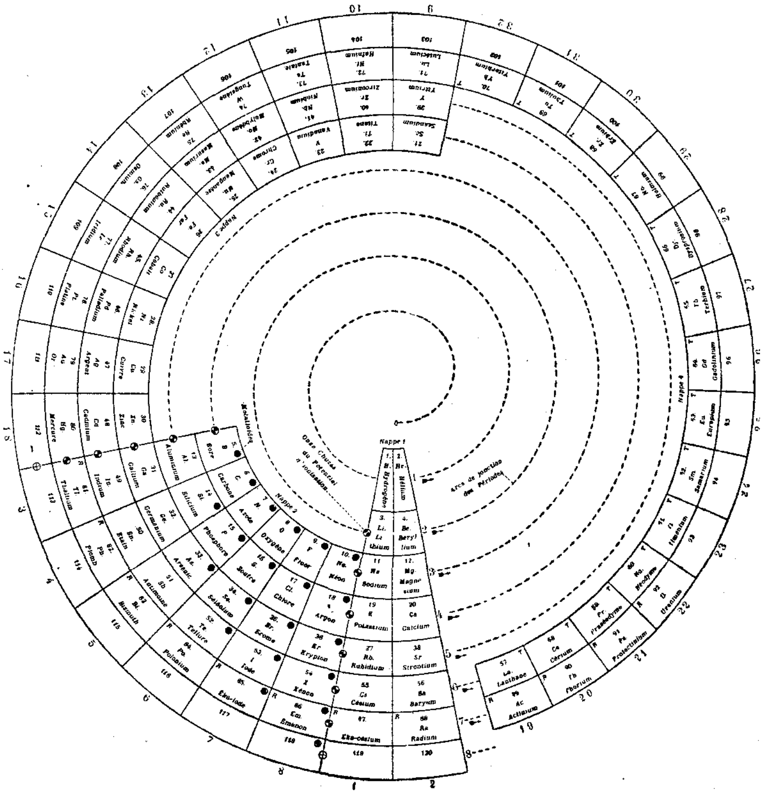


Fig. II.

The occupant of each position in the Table is made up of a pliaide of atoms, the various isotopes, and the values for each are the initial, fundamental atom of atomic weight, A_0, which is the lightest of the isotopes, and is the most important from the evolutionary point of view. This proto-isotopic atom is composed of an exterior part (the planetary system) and an interior, or nuclear, part. The planetary system is composed of electrons equal to the atomic number of the element, N. Whilst this wider planetary system is composed of negative electrons, the compact nucleus is one whole proton. The electrons have no appreciable weight, therefore the weight of the atom is A_0, the weight of its nucleus, which is equal to the number of protons present.

The starting point for the modern arrangements to show the periodicity of the elements is Mendeleieff's (1871) empirical classification, which originally required one

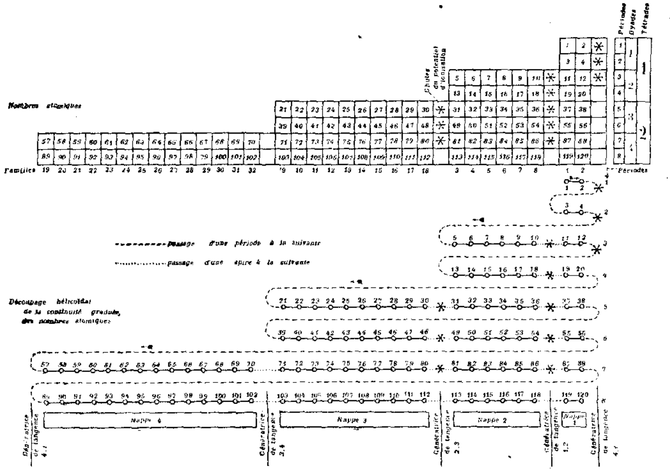


Fig. IV.

or two inversions in order to bring certain elements into their true groupings. These inversions have since been found to be entirely justified by experiment. Since the time of Mendeleieff the inert gases have been discovered and a place for them must be found in any classification. The gases from Helium to Radium Emanation, and the rare earth elements have presented difficulties in effecting a complete classification of chemical elements. Again, spaces have been left for elements whose existence is expected but which have not yet been discovered. In the case of several of these the blanks have already been filled.

The helicoidal scheme now advanced is based upon Moseley's Law,

$$\sqrt{\frac{c}{\lambda}} = a(N-b)$$

where λ = wave length,
c = velocity of light
N = Atomic number and a and b are constants.

From this Law the number of the rare earths is fixed at 14. Neither Moseley's Law nor Bohr's scheme for the atom are opposed to the extension of the series and this is indicated by the helicoidal representation of the elements.

It has hitherto been customary to place Helium at the head of the Group of inert gases. A number of considerations, however, point to this element being regarded as at the head of the alkaline earth metals. Reference to Fig. I shows how this has been done and indicates the arrangement for the four typical groups

7 Halogens
8 Rare Gases
1 Alkalis
2 Alkaline Earths.

This apparently irregular order is found, however, to be quite regular by reference to the helical representation, Fig. II.

(To be continued.)

POLISH LAW ON FOREIGN COMPANIES.

The Board of Trade have been informed by the Foreign Office that a Polish Decree, dated 20 December, 1928, lays down the conditions on which foreign joint stock and limited liability companies will be permitted to operate in Polish territory.

The text of the Decree may be consulted at the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

AN ANALYSIS OF THE ARC AND SPARK SPECTRA OF YTTRIUM (Yt I and Yt II).

By William F. Meggers and Henry Norris Russell.

(*U.S. Bureau of Standards.*)

All the available data (wave-length measurements and intensity estimates, temperature classes, Zeeman effects) on yttrium lines have been correlated and interpretated in an analysis of the arc and spark spectra. The total number of lines classified is 448 in the Yt I spectrum, 223 in the Yt II spectrum, and 10 in the Yt III spectrum.

Series-forming terms have been identified in each of the spectra, and from these the ionisation potentials of 6.5 volts for the neutral Yt atom, 12.3 volts for the Yt+ atom, and 20.6 volts for the Yt++ atom have been deduced.

Yttrium is a chemical analogue of scandium, and the corresponding spectra are now seen to be strikingly similar. A ^2D term (from a *d* electron) represents the lowest energy (normal state) o fboth Sc III and Yt III, and another ^2D (from the s^2d configuration) describes the normal state of Sc Iand of Yt I. The configurations which do not contain a *d*-electron are much lower in Yt II than in Sc II; a consequence of the fact that the *s* and *p* states in Yt III are lower compared with the *d* state than in Sc III. This results in $^1S_0$ (s^2) as the normal state for Yt II, while it is ^3D (*sd*) for Sc II.

The analyses of Yt I and Yt II spectra are supported by measurements of Zeeman effects, which are interpreted with the aid of Landé's theory of Zeeman effects and multiplet structure. All details of the three spectra, Yt I, Yt II, and Yt III, are in accord with Hund's correlation of spectral terms with electron configurations.

THE MAGIC OF COAL.

By Dr. M. A. Matthews.

"The systematic study of liw temperature carbonisation processes promises to be of material assistance in restoring the prosperity of the coal fields," said Dr. M. A. Matthews in the course of a lecture at the Sir John Cass Technical Institute, London, on Monday, May 27.

Dr. Matthews pointed out the fact that there were at present in Great Britain 48 companies, representing a capital of eight million pounds sterling, directly interested in the low temperature carbonisation of coal showed how commercially important the process had become. The chief products of low temperature carbonisation were :—

(1) A smokeless fuel, the use of which was expected to solve the smoke nuisance.

(2) A rich gas of very great heating power.

(3) Tar.

"When the chemical nature of low temperature tar is more fully understood there can be no doubt that many further uses will be found for it," declared Dr. Matthews. The presence of several interesting chemical substances had been demonstrated by the Chemical Research Laboratory. From the commercial point of view the low temperature carbonisation of one ton of bituminous coal produced directly about four gallons of excellent motor spirit but this amount could be greatly increased by suitable treatment of the higher boiling fractions of the tar. Such treatment might consist of a cracking process by simple distillation under pressure as long practised in the petroleum industry, but experiments indicated that much more satisfactory results would be obtained by a combined cracking and hydrogenating process.

Among other products which could also be obtained from low temperature tar were lubricating oils, fuel and Diesel oils, powerful disinfectants from tar acids, and resins suitable for use as paints, varnishes, insulating material, etc., while the pitch had been found useful in the manufacture of roofing material and as a binding agent for patent fuel.

It is anuounced that work has just begun on the erection of extensive refineries on the banks of the Humber at Killingholme, where British low temperature tars will be treated by the Gyro vapour-phase cracking process which deals satisfactorily with the higher fractions of tar oils and produces a very high grade motor spirit. Capital to the extent of nearly half a million pounds has been subscribed for this important project of motor-spirit and oil-fuel production from British coal oils.

INTERNATIONAL COMBUSTION, LTD.

A dividend of 6 per cent. on the preference shares was declared on the 29 May, 1929.

THE INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE, 1928-29.

The Industrial Fellowship System of Mellon Institute not only has successfully aroused the interest of American manufacturers in research, but also has appealed to their imagination in a practical way. This is clearly indicated by the progress made during the Institute's fiscal year ended February 28, 1929. This year, the eighteenth since the establishment of the Institute at Pittsburgh, was one of progress in the continued development of its activities, and was featured again, among other things, by an exceptional increase in the amount of money spent in sustaining fellowship research.

The properties acquired by the Institute in December, 1927, through gift from Messrs. Andrew W. Mellon and Richard B. Mellon, its founders, have been altered extensively and have provided additional laboratories and offices, which have made possible the increased growth of the Institute during the year. The Department of Pure Research and fourteen Industrial Fellowships have been transferred to these additional quarters. However, this space is inadequate to meet the demands, and during the past year the Institute has been forced to decline investigations of importance, offered by some of the strongest corporations in the country.

The results obtained during the year in solving manufacturing problems, in extending uses for industrial products, and in creating new products and new processes of manufacture were in keeping with the increased financial support. The research accomplishments in the fields of fertilisers, organic solvents and resins, moulded paper articles, insecticides, foods, chrome plating, ceramic products, insulation, kiln studies, and vitreous enamel are especially notable.

Harold K. Work developed a successful process for chrome plating of aluminium, which has had wide application in industry. R. E. Arnold and his co-workers made a very extensive investigation of kiln construction and operation for the vitrified sewer pipe industry, which has resulted in a large saving in fuel and likewise in increased efficiency in operation. E. W. Reid and his associates have made valuable contributions to the lacquer industry through the development of new solvents and resins. The Carbide and Carbon Chemicals Corp. came into being as a result of developments made in the Institute, and the production of these new solvents is a continuation of this programme. H. H. Meyer's research has resulted in the construction of a new fertiliser plant which incorporates important advances in the technology of the fertiliser industry. The Institute's investigation in the field of smoke abatement—1911-14, 1923-24—has received wide recognition. This research is of such great importance, not only to the city of Pittsburgh, but to every city, that the work has been re-established during the year.

Several fellowships are so well established in their fields of inquiry, that they are renewed year after year. This attests to their productivity and to the confidence which their donors have in the Institute. The incumbents of the larger and older Industrial Fellowships are recognised generally as specialists in the particular branches of technology in which they are carrying out investigations.

One principle of scientific research is that no one can succeed in laboratory experimentation without benefiting his fellow men. If a scientist is productive in his investigations, it follows that he will receive the necessary financial support to carry on his work and, when the results are applied in industry, humanity receives the benefits. The line of conduct that the Institute pursues as best for the interests of the donors of its Fellowhips has regard for public welfare, and in accordance with this guiding principle the institution is constantly becoming more active in educational work in the field of science through lectures, radio talks, and publications by its members. The policy of encouraging scientific research in various other universities and institutions has been continued by providing financial support for certain extra-Institute investigations which are of importance to technology.

Co-operation is a large factor in the success of the Institute. Team-work and high creative ability go together, which principle, having been made vital by the founder of the Industrial Fellowship System, Dr. Robert Kennedy Duncan, is now a valued heritage of the Institute. The first duty of an Industrial Fellow is to find out what his donor knows concerning the Fellowship problem and what he has tried in its solution; because it is only by combining what the donor knows with what the Fellow and the Institute know and will learn that satisfactory progress can be made in solving the problem accepted for investigation.

It is imperative that every industrial research man keep his mind open on every

question until the evidence is all in, and that he listen to the man who knows. He soon learns from experience not to ridicule new ideas and not to hesitate to ask his adviser or a laboratory co-worker to help him. To this end everyone engaged in research should study himself and should know his own abilities and limitations.

GENERAL NOTES.

CHANGES OF ADDRESS IN TURKEY.

The recent substitution of a Latin alphabet for Turkish characters has in some cases necessitated slight modifications in the form of the names and addresses of Turkish firms.

British firms trading with Turkey are advised to watch for changes in the addresses of their agents and customers, and to make use of the new style and addresses as soon as possible in order to avoid delays to their correspondence. Advantage has been taken of the changes to alter the spelling of Mersina, which has now become Mersin. This will avoid confusion, which frequently occurs, with Messina, and letters to Mersina should now be addressed " Mersin, Turkey," and not " Mersina, Turkey-in-Asia."

GREAT ADVANCE IN CANADIAN CHEMICAL PRODUCTION.

In the course of an address given by Mr. S. J. Cook, Chief of the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics, at the Chemical Exposition held recently at New York City, Mr. Cook mentioned that during 1928 the total production of Canadian plants in the chemical industry reached a value of $143,000,000, as compared with a total of $127,484,672 in 1927, a substantial increase of over $15,500,000.

Canadian imports of chemical products during the year were valued at $86,968,894, of which products worth $25,428,284 were purchased from the United States. Exports of Canadian chemical and allied products during the year were valued at $18,856,645, of which one-half was sold to customers in the United States. The total consumption of chemical products in Canada during the year is therefore reckoned at about $162,000,000, an increase during the twelve months of $19,000,000, and a per capita consumption of $16.20.

In 1928, the capital investment in the 569 plants was about $146,000,000, a figure which is almost the same as the value of the year's production. The net value of production, calculated as being the value added to raw materials by manufacturing processes was about $70,000,000.

SATISFACTORY PROGRESS OF ONTARIO RESEARCH FOUNDATION.

According to a statement recently issued by the Prime Minister of Ontario, funds continue to come to hand for the establishment of the Ontario Research Foundation, the total received to date being $1,900,000. As the Provincial Government is pledged to contribute dollar for dollar to the fund raised by private, the undertaking is assured of a total capital in the neighbourhood of $4,000,000.

Work is to be started immediately on the erection of ten new laboratories at the Foundation's headquarters in Queen's Park, Toronto, the cost of the extensions being $150,000.

RADIOTELEGRAPH AND RADIO-TELEPHONE STATIONS IN CANADA.

The Department of Marine and Fisheries at Ottawa has just issued a map of the Dominion, scale 100 miles to one inch, on which are shown the radiotelegraph and radiotelephone stations operating as radio aids to navigation.

These stations include a number of new ones in Hudson Strait along the track of steamships which may be expected to use the new route to be opened up following the completion of the Hudson Bay Railway; as well as those older stations on the Atlantic and Pacific Coasts.

Copies of the map in question will be obtainable shortly on application to the office of the High Commissioner of Canada, the Canadian Building, Trafalgar Square, London, S.W.1.; or from the Department of Marine and Fisheries at Ottawa.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Bakerian Lecture, Thursday, June 6 :—

The Structure and Opacity of a Stellar Atmosphere. By E. A. Milne, F.R.S.

The abstract problem of stellar atmospheres is the study of the properties of a layer of gas given (1) the net flux of energy πF to which it is exposed from below; (2) the gravitational field of acceleration g to which it is subject. The two parameters F

and g correspond to the observal classification of stellar spectra (1) in types correlated with colour-temperature; (2) inside a given type, in differences correlated with absolute *luminosity*. If $\pi F = \sigma T_1^4$, where σ is Stefan's constant, T_1 is called the effective temperature of the star. To calculate the nature of a stellar spectrum we have to investigate (*a*) the thermal structure of the atmosphere given F or T_1, (*b*) the mechanical structure given g. The former (*a*) determines the actual temperature T at any point in terms of T_1, as a function of optical depth, and determines also the forms of the contours of absorption lines in terms of *monochromatic scattering coefficients*. The latter (*b*) determines the pressure at various levels. To correlate actual levels with optical depths requires a knowledge of the absolute value of the absorption coefficient for the continuous spectrum — the intrinsic opacity of the photospheric layers. Once the opacity is known, the whole of the properties of the atmosphere in a steady state become calculable.

Investigations relating to (*a*) derive from two fundamental idealised problems, which may be called Schwarzchild's problem and Schuster's problem. The solution to Schwarzchild's problem determines the temperature distribution for "grey" absorption. The solution to Schuster's problem determines the form of an "absorption line" for purely monochromatic scattering by material in front of a bright "photospheric" radiating surface. Since in an actual atmosphere "reversing layer" merges into "photospheric layers," a fusion of the two problems is required. The mixed problem is here solved in the general case. The principal result is that for the study of the atoms producing an "absorption" line at a point on a line-contour where the intensity-ratio is r, the "photospheric surface" should be drawn at an optical depth $\tau = {}^4/_3\, r/(r+1)$.

account of the dependence of ionisation on

Investigations relating to (*b*) must take account of the dependence of ionisation on pressure, first pointed out by Saha. It is shown how to calculate the number of neutral or ionised atoms in a column down to given electron pressure P, allowing accurately for the varying ionisation with varying level. P and τ are then connected by the absorption coefficient κ of photospheric material, assumed due to photo-electric processes and governed by the formula $\kappa = \alpha P/T^{9/2}$.

The observed temperature $T_{max.}$ of greatest width of a given absorption line for given r in the stellar sequence of spectra determines P_0, the partial electron-pressure at the base of the column of atoms. P_0 *determines the mass of the column, given g*, and r determines its optical thickness τ by the formula already given. Dividing the optical thickness by the mass we have the absolute value of the photospheric absorption coefficient from purely astrophysical measures.

Applying this "method of maxima" to a Zn triplet which has its maximum in stars of type Go, and taking the sun and Capella (bright compouent) as typical dwarf and giant of this type, accordant determinations of photospheric opacity are found, the mean giving

$$\kappa = 0.85P/(T/10^4)^{9/2}.$$

P being measured in dynes cm.$^{-2}$. At the relevant depths, the values of κ are 300 for the sun and 60 for capella. Miss Payne and Miss Williams' recent determination of the Balmer maximum in A-type stars gives $\kappa = 150$, and leads to a constant of proportionality in κ of the same order as above.

The determination of κ makes possible a calculation of the "number of atoms above the photosphere" for all elements in all stars, in terms of assumed absolute abundances. Calculations are made in detail for calcium at low temperatures and compared with Payne and Hogg's determinations by Unsöld's method.

The dependence of κ on P is strongly confirmed by the observed "absolute magnitude" effect for the Balmer lines at low temperatures; were κ independent of P, absolute magnitude effects would occur at high temperatures only.

Tables were given showing the calculated physical state of the photospheric layers of the sun and Capella, based on the absolute determination of opacity.

THE CHEMICAL SOCIETY.

Thursday, June 6.

The Production of Kojic Acid from Pentoses by Aspergillus oryzæ. By F. Challenger, L. Klein, and T. K. Walker.

Aspergillus oryzæ grows well on arabinose and in 2-3 days the culture gives the red colour with ferric chloride characteristic of 3-hydroxypyrones. Extraction of the culture with ether gives kojic acid; no pyromeconic acid could be isolated. The re-sterilised culture again gave kojic acid on inocu-

lation and incubation. The non-formation of pyromeconic acid is remarkable since it is so closely related to arabinose, whereas the formation of kojic acid involves a breakdown of the pentose molecule and the synthesis of a 6-carbon compound. *A. oryzæ* will not grow on pyromeconic acid, which is evidently toxic, and this may explain the preferential synthesis of the harmless kojic acid, which is also readily produced from xylose and the mould. The mould grows well on glycuronic acid, but no comenic acid, kojic acid or any pyrone derivative could be detected. Comenic acid is also toxic to *A. oryzæ*, but it is interesting that decarboxylation of the glycnronic acid to xylose and subsequent formation of kojic acid does not occur. Putrefactive bacteria convert glycuronic acid to exylose. From rhamnose a 3-hydroxypyrone derivative is also formed in poor yield, but has not yet been obtained pure.

The Properties of the Chlorides of Sulphur. Part II. Molecular Extinction-Coefficients. By T. M. LOWRY AND G. JESSOP.

The red component of the chlorides of sulphur is sulphur dichloride, SCl_2; this can be estimated by absorption of light of wavelength 5200 or 5400 A, to which the monochloride and chlorine are completely transparent. Colorimetric analysis shows that the ilquid dichloride is dissociated to the extent of about 16 per cent. at atmospheric temperatures.

Sulphur tetrachloride is not formed in appreciable quantities in the liquid chlorides of sulphur, which behave as ternary equilibrium mixtures, to which the law of mass action can be applied in accordance with the equation $2SCl_2 \longleftrightarrow S_2Cl_2 + Cl_2$.

The Isomerism of Derivatives of 2-phenylnaphthylene-1 : 3-diamine. By M. S. LESSLIE AND E. E. TURNER.

It has been shown that the α- and β-forms of NN′-dimethyl-2-phenylnaphthylene-1 : 3-diamine are not stereoisomerides as suggested by Gibson, Kentish, and Simonsen (J., 1928, 2131), but are structural isomerides. It is also shown that the parent diamine exhibits the reactions of one or other of several tautomeric forms according to the reagent employed. The parent diamine has been optically resolved; its optical activity was required by the theory now advanced, and the resolution appears to demonstrate the correctness of the theory.

Studies of Valency. Part XIII. Further Experiments on the Molecular Structure and Configuration of the Quadrivalent Derivatives of Tellurium. By T. M. LOWRY AND F. L. GILBERT.

The properties of the quadrivalent derivatives of tellurium are discussed in the light of the structure recently assigned to the β-compounds by Drew.

THE OPTICAL SOCIETY.

Thursday, June 13.

Experiments, Demonstrations and Exhibits, arranged by the Technical optics Department of the Imperial College, with the kind permission of the Director, Prof. A. O. Rankine, O.B.E., D.Sc.

Exhibits of new Theodolites by Messrs. Cooke, Troughton & Simms, Ltd.; Messrs. E. R. Watts & Son, Ltd.

The following paper was presented and discussed :—

The Beam Given by Dioptric Apparatus. By W. M. HAMPTON, Ph.D., B.Sc., F.Inst.P., A.I.C.

GEOLOGICAL SOCIETY.

May 8, 1929.

Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the chair.

Communications read :—

The Glaciation of Eastern Edenside, the Alston Block, and the Carlisle Plain. By FREDERICK MURRAY TROTTER, M.Sc., F.G.S.

Three glaciations separated by intervals within the glaciation have been recognised in Edenside.

The retreat of the ice-front after the maximum of the Main Glaciation can be traced stage by stage, the following being the chief events in chronological order :—(1) Successive sptilting-off, from east to west, of the Tast Allendale, West Allendale, and South Tyne glaciers from the ice in the Tyne Gap area; (2) Damming-up of glacier-lakes along the western slopes of the northern end of the Cross-Fell escarpment, and along the western slopes of the Bewcastle Fells, the drainage of both systems escaping into the Tyne; (3) Recession of the Edenside Glacier from the Galloway ice; and (4) Recession of the Cross-Fell ice from the Lake-District ice by successive splitting-off, from north to south, of six valley-glaciers of the Cross-Fell Inlier.

A Marine Triassic Fauna from Eastern Persia. By JAMES ARCHIBALD DOUGLAS, M.A., D.Sc., F.G.S.

This paper gives an account of the discovery by Mr. R. C. Jennings and Mr. K.

Washington Gray, geologists of the Anglo-Persian Oil Company, of a marine Triassic fauna in Eastern Persia. It is the first detailed record of rocks of that age from the wide stretch of country lying between the known Triassic outcrops of Asia Minor and Afghanistan. The district of Naiband, from which the collection was made, lies about 150 miles north of Kerman and 330 miles due east of Isfahan, forming part of the Median Mass within the folded zone of the Iranian Nappes. A study of the fauna shows that at least three distinct groups can be recognised :—

(3) A black limestone-and-shale group of Hauz-i-Khan, containing corals and brachiopods of Rhætic age.

(2) A calciferous sandstone group of Naiband, containing a rich lamellibranch fauna of Noric age.

(1) A lower shale group of Hauz-i-Sheikh, containing a micro-fauna, chiefly gasteropods, which have affinities with those of the St. Cassian Beds.

Comparison is made with other Triassic outcrops, and the evidence is found to suggest an extension of the Triassic Tethys into Persia in Ladinic times, and again at a later stage, in the Rhætic Period. During the intervening Noric epoch, however, communication with the Mediterranean province was severed, while species characteristic of the Trias of the East Indies make their appearance in great numbers. It is shown that there is little evidence for migration having taken place between the two areas along the 'Himalayan route,' and it is suggested that the continental barrier of Gondwanaland was breaking up into an archipelago of islands, possibly somewhat similar to the East Indies of the present day, which would have formed no barrier to the distribution of a terrestrial flora, but through which a marine fauna of littoral facies could have passed.

May 29.

The Pliocene and Pleistocene Deposits of Wadi Qena and of the Nile Valley Between Luxor and Assiut (Qua). By K. S. Sandford, Ph.D., M.A., F.G.S.

Miss E. W. Gardner, F.G.S., also gave an account of geological researches in the Fayûm (Egypt), being a report on work done with the assistance of the Gloyne Outdoor Geological Research Fund.

On June 12, Dr. E. Mackenzie Taylor, of the School of Agriculture in the University of Cambridge, delivered a lecture on *Base Exchange, and its Bearing on the Formation of Coal and Petroleum.*

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Solidifying Curves of Binary Systems Containing Nitroglycerine. By Mosaku Kurita and Ichiro Hagui.

Viscosity and Density of Binary Systems above their Boiling Points. By Hisashi Kuhara.

Bimolecular Alkaloids. I. On the Reduction of Disinomenine (Dehydrosinomenine) and on ϕ-Sinomenine. By Kakuji Goto.

Bimolecular Alkaloids. II. Decomposition of ϕ-Sinomenine. By Kakuji Goto and Hideo Suzuki.

On a Glucoside in the Root of Peucedanum decursivum Maxim. Part V. Spectroscopic Studies on Nodakenin and its Derivatives. By Junzo Arima.

Amino-acid Anhydrides. IV. Molecular Compounds of Diketopiperazine with Salts of Heavy Metals. By Tei-ichi Asahina and Tsurumatsu Dono.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

April Examinations, 1929.—Pass List.

Examination in General Chemistry for the Associateship.

Cowpe, William (Royal Technical College, Salford; and Chelsea Polytechnic); Duncan, John Ronald Macfarlane (Royal Technical College, Glasgow); Geary, John Stanley (Municipal Technical College, Hull); Marchant, Laurence Herbert George, A.M.C.T. (College of Technology, Manchester); Metcalf, Howard (Technical College, Birmingham); Newns, John Edward, A.M.C.T. (College of Technology, Manchester); Ormrod, George Wallace, A.M.C.T. (College of Technology, Manchester); Pavitt, William Frank (University College, London); Pocock, Benjamin (Technical College, Leeds); Shelmerdine, Ernest John, A.M.C.T. (College of Technology, Manchester, and Technical College, Derby); Tetley, John Lewis, B.A. (Cantab.) (The University, Cambridge).

Examination in General Chemistry for the Associateship held in India in January, 1929 :

Iyer, Venkatrayar Gopalam, B.A. (Madras) (The University, Madras).

Examination for the Fellowship :

In Branch E : The Chemistry, including Microscopy, of Foods and Drugs, and of Water :

Howes, Herbert Stanley, B.Sc. (Bris.); Morris, Fred, A.M.C.T.; Shortt, William Methuen, M.Sc. (Manc.); Smith, Laurence Frederick, M.Sc. (Lond.), A.R.C.S., D.I.C.

In Branch G : Industrial Chemistry : Hannah, James Dickson M.Sc. Tech. (Manc.); Stewart, Daniel, B.Sc. (Edin.).

ROYAL INSTITUTION.

A General Meeting of the Members of the Royal Institution was held on June 3, Sir Robert Robertson, Treasurer and Vice-President, in the chair. Lord Ashfield, Lord Queenborough, Lady Brunner, Mr. O. Krishaber, Mr. H. W. P. Matthey, Mrs. Phillips and Miss Woodroffe were elected Members. The Special Thanks of the Members were returned to Mr. A. C. Ionides for his present of original spectrographs by the late Sir William Crookes, of Athenian Coins.

NOTICES OF BOOKS.

Abderhalden's Handbuch der Biologischen Arbeitsmethoden. Abt. I, Chemische Methoden, Teil 2, 2-Hälfte, Heft 4 (Lieferung 294). *Darstellung Metallorganischer Verbindungen.* By E. Klarmann. Pp. 2149-2307. Berlin & Vienna : Urban and Schwarzenberg. 1929. Price 8 marks.

The organic derivatives and compounds of many metals are of extreme biological importance. Those of antimony and arsenic have now been employed medicinally for some time and the derivatives of other metals, including silver, bismuth and tin, are beginning to find application, too. The present volume on the preparation of some of these bodies by Prof. Emil Klarmann of New Jersey in Prof. Abderhalden's important Handbook is thus of considerable interest. An account is given of the early work in the middle of last century on the zinc alkyls and there is a brief description of the magnesium compounds (Grignard's reagents). Considerable space has rightly been allotted to the mercury and arsenic compounds and over 150 pages are devoted to the compounds of tin, with which the reviewer is most familiar. Emphasis is laid upon the work of Krause in America, who obtained many new bodies by working in liquid ammonia. Mention is also made, but very briefly, of some of the derivatives obtained by the interaction of alkali stannite solutions on alkyl haloids. A number of papers on these substances appeared in *The Chemical News* (1920-23), but no reference is made to any of them although the references in the footnotes are a feature of the volume. Yet there is apparently no citation of any article appearing in this Journal in spite of the fact that from 1859 onwards much original work on the organo-metallic compounds has been published in the *Chemical News.*

The alkali metals, berylium, calcium, cadmium, aluminium, germanium, lead, vanadium, chromium, iron, platinum and thallium all form organic compounds. Those compounds of the last named metal have been specially studied by A. E. Goddard, who has contributed an important volume on these organi-metallic compounds to Prof. J. Newton Friend's *Textbook of Inorganic Chemistry* (reviewed in the *Chemical News*, 1929, cxxxviii, 61) and which book is to be preferred for its comprehensiveness and discrimination to the work now under notice.

J. G. F. Druce.

Blonde or Brunette? A Complete Account of the Theory and Practice of Hair-Dyeing in all its Branches. By H. Stanley Redgrove, B.Sc., A.I.C., and Gilbert A. Foan. Pp. xii + 132 + 3 plates. London : William Heinemann (Medical Books, Ltd.), 99, Great Russell Street, W.C.1. 1929. Price 7s. 6d. net.

It is perhaps not generally recognised that hair-dyeing constitutes an important branch of applied chemistry. Unfortunately, the subject has been very largely allowed to fall into the hands of charlatans; nevertheless, some important researches have been carried out to discover suitable substances for dyeing the hair, particulars of which will be found in this admirable book, one of whose objects, as stated in the preface, is to stimulate further research on the part of chemists.

It is a remarkable and very welcome book for two important reasons. In the first place, it is almost the only book, with which we are acquainted, exclusively devoted to the subject, in any language, and certainly by far the most comprehensive. In the second place, the authors have achieved what by many might have been considered an impossible task, namely, the production of a volume making a strong appeal to three entirely different classes of readers.

The interest of the general reader is sustained by the authors' style which leaves nothing whatever to be desired in point of clarity, and by the many apt illustrations and details of historical and practical interest.

Members of the hairdressing and beauty culture professions will find the book a completely satisfactory trade manual, the practical side of hair-dyeing and all subsidiary processes, such as shampooing and drying the hair and the treatment of postiche being

treated with a wealth of detail and useful advice of a practical character.

Finally, as indicated above, the strictly scientific side of the subject is most satisfactorily handled. The most recent researches on the chemistry of *Lawsonia alba, Anthemis nobilis, and Matricaria Chamomilla,* three plants of great importance in the art of hair-dyeing are dealt with in detail, as is also the chemistry of the simpler metallic dyes and those based on para-phenylene-diamine and other diamines and amino-phenols. The reactions taking place when hair is dyed with these and other substances, which are not always as simple as may appear at first sight, are fully investigated, and the question of the natural pigmentation of hair is fully considered from both the physiological and chemical standpoints.

Armstrong's quinnoid theory of colour is referred to, and it is evident that the authors, though not prepared to commit themselves, consider the theory to be distinctly useful. The question of the toxic action of certain dyes and the formation of the very toxic quinone-di-imine as a stage in the oxidation of para-phenylene-di-amine are questions which are fully considered, the book containing much helpful advice to the general reader concerning the avoidance of toxic dyes and the general care of the hair.

A word of praise should be given to Miss V. A. Venables, the artist responsible for the bulk of the many admirable illustrations which add to the attractiveness of the book.

The book contains a very complete Index and a useful Bibliography.

Report of the Benzole Research Committee.

The Sixth Annual Report of the Joint Research Committee of the National Benzole Association and the University of Leeds has just been issued.

The work that has been carried out by this Committee and the Report which has been compiled represents co-operative effort for the purpose of research between representatives of a large and important British Industry and those of London University. Their past reports is some indication of the success of their effort.

The nature of the work carried out, and the subject matter, is of special interest at the present time, for it represents an attempt at the application of systematic research to increase the supplies of benzole motor spirit produced in this country from coal.

Attention has been given to the question of resin formation in benzoles, the efficiency of absorbent washing oils and other matters and includes an extensive bibliography of recent research in this field.

Forthcoming Events.

INSTITUTE OF METALS.

ANNUAL MEETING AT DUSSELDORF.

The Council is now able to give preliminary details of the previously announced Annual Autumn Meeting, which, thanks to the very kind invitation of the Verein Deutscher Ingenieure and of the Deutsche Gesellschaft für Metallkunde, will take place in Düsseldorf from Monday, September 9, to Thursday, September 12. An influential Local Reception Committee has been constituted under the direction of Herr Dr. Heckmann, the Honorary Local Secretaries being Herr Dipl.-Ing. Patzak and Herr Dr.-Ing. Max Haas. It is hoped that the Meeting, which is the first held by the Institute in Germany, will be well attended, and that you will be able to accept the hospitality to be offered.

Members will assemble in Düsseldorf on Monday, September 9, when the office of the Honorary Local Secretary will be open for the distribution of tickets and badges. This office will be situated at the Breidenbacher Hof Hotel, which will be the official headquarters of the Institute in Düsseldorf.

In the afternoon on Monday, September 9, the Eighth Annual Autumn Lecture will be delivered by Dr. A. G. C. Gwyer, B.Sc., on "Aluminium and its Alloys." Members will be free to make their own arrangements for the evening.

On Tuesday, September 10, the morning will be occupied by the reading and discussion of Papers, the afternoon being devoted to visits to Works. In the evening the City of Dusseldorf will entertain members and their ladies to dinner.

In the morning of Wednesday, September 11, further papers will be presented for discussion and the business meetings will be brought to a conclusion. The afternoon will be devoted to visits to works, and in the evening there will be a cabaret and dance in the Rheingoldsaal.

For Thursday, September 12, an all-day trip will be arranged to Essen to visit the Works of Messrs. Friedrich Krupp, Essen.

The party will return to Düsseldorf in time to allow Members who must return at

once to England to travel by the night boat train. For other Members extensions are being arranged, one including a trip through Holland and another a visit to Berlin.

The travelling arrangements for those Members who desire to proceed with the Institute party will be in the hands of Messrs. Thos. Cook & Son, Ltd.

Members are invited to attend Meetings of the Deutsche Gesellschaft für Metallkunde and other German metallurgical societies which are being held in Düsseldorf prior to the Institute of Metals Meeting—on Saturday, September 7 and Sunday, September 8. Special travelling arrangements to meet the requirements of these Members will be made on request, by Messrs. Thos. Cook & Son, Ltd.

A detailed programme of the meeting—the present programme being of a provisional character—will be issued in July. In the meantime it will be of great assistance to the Reception Committee, in making their arrangements, to know, approximately, how many Members may be present.

A registration fee of 10s. 6d. will be charged in the case of each Member attending, the fee for each Lady being 21s.

ELECTION OF MEMBERS.

Applicants for Membership who are desirous of being elected in time to participate in the Meeting should forward their applications to the undersigned as soon as possible : an election is arranged for July 4. It is hoped that Members will be good enough to bring this notification to the knowledge of those who may be desirous of applying for Membership of the Institute.

EMPIRE MINING AND METALLURGICAL CONGRESS, SOUTH AFRICA, 1930.

Members are invited to take part in, and to contribute Papers to, the Third (Triennial) Empire Mining and Metallurgical Congress, to be held in South Africa in 1930.

Owing to the great number of non-Members of the Institute of Metals who are anxious to take part in the Düsseldorf Meeting of the Institute, to be held on September 9-12, the Council of the Institute will meet specially on July 4, to consider applications for membership of the Institute.

Only Members of the Institute will be able to take part in the various functions in connection with the Düsseldorf Conference, which will be very largely attended and is expected to ge a great success. The Institute is visiting Germany at the invitation of the Verein Deutscher Ingenieure and the Deutsche Gesellschaft für Metallkunde.

GEOLOGICAL SOCIETY.

Wednesday, June 26.—"The Geology of the District around Abbey-Cwmhir (Radnorshire)." By R. O. Roberts, M.Sc. Communicated by Prof. W. J. Pugh, O.B.E., D.Sc., F.G.S. "The Geology of the Country around Bodfean (South-Western Carnarvonshire)." By C. A. Matley, D.Sc., F.G.S., and Albert Heard, Ph.D., M.Sc., F.G.S.

ROYAL SOCIETY OF ARTS.

Wednesday, June 26, at 4 p.m.—Annual General Meeting.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

16,166.—Ashcroft, E. A.—Production of metal chlorides, etc. May 25.

16,194.—Barnes, R. S.—Dyestuffs. May 25.

16,003.—Bataafsche Petroleum Maatschappij)—Manufacture of alcohols. May 23.

15,962.—I. G. Farbenindustrie Akt.-Ges. —Polymerisation of diolefines. May 23.

15,991.—Naamlooze Vennootschap Chemische Fahriek Servo, and Rozenbrock, M. D.—Sulphonating fatty acids, etc. May 23.

Specifications Published.

311,788.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.)—Production of mono or polyhydric alcohols.

311,748.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Manufacture of stable solutions of salts of stibinic acids.

285,488.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of aniline-2 : 5-disulphonic acid.

287,064.—Hale, W. J., and Haldeman, W. S.—Method of producing organic acids.

311,862.—Tern, R.—Manufacture of sulphur trioxide and sulphuric acid.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

309,155.—Liquid fuel; turpentine.—Steiger, W., St. Blaise, Neuchatel, Switzerland.

Motor spirit consists of aqueous alcohol and an oil saturated with acetylene. Gasolene, benzine, benzol, or toluol, or a mixture thereof, or other naphtha distillates may be added. In an example, 10 litres of turpentine are saturated with acetylene, and 30 litres of benzine, 0.5-1.0 litre of gasolene, and 0.5 litre of toluol added. 50 c.c. of commercial lysol, or of a solution of creosol and neutral soap, are stirred in, and the whole allowed to settle, whereby resinous matters in the turpentine are precipitated. The liquid is decanted and added to 100 litres of raw spirits containing up to 20 per cent. of water.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

TELION.

501,790.—Chemical substances used for agricultural, horticulaural, veterinary, and sanitary purposes.—The British Dermic Co., Limited, 176, Upper Thames Street, London, E.C.4. May 22.

OPACOL.

499,708.—Chemical substances prepared for use in medicine and pharmacy.—May & Baker, Ltd., Garden Wharf, Church Road, Battersea, London, S.W.11. May 29th.

HILLSKINGUE.

501,862.—Chemical substances prepared for use in medicine and pharmacy.—David Hill, Queen's Head Inn, 11, Harbour Terrace, Workington, Cumberland. May 29.

PANSEDOL BRAND.

501,528.—Chemical substances prepared for use in medicine and pharmacy.—H. R. Napp, Limited, 3 and 4, Clements Inn, Kingsway, London, W.C.2. May 29.

"CHEMICAL NEWS"—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, "CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered througn any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices: MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices: MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

URGENTLY WANTED

TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.

also

No. 3400 Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3610.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

The Action of Air Carbon Tetrachloride Vapour Mixtures on Several Natnral Sulphides, Sulpharsenites and Sulphantimonites ... 385
By K. Braddock-Rogers.
Dull Lustre Viscose ... 387
The Helicoidal Classification of the Elements ... 388
By Charles Janet.
General Notes:—
Overseas Trade ... 393
Determination of Zinc Oxide in Paints ... 394
Reform of the Patent Law ... 394
Commemoration Day at Livingstone College ... 394
Manufacture of Sulphuric Acid in Canada ... 395
Commonwealth of Australia—Council for Scientific and Industrial Research ... 395
Proceedings & Notices of Societies:—
The Royal Society ... 397
The Physical Society ... 398
Notices of Books ... 398
Forthcoming Events ... 399
New Patents ... 399
New Trade Marks ... 400

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

THE ACTION OF AIR CARBON TETRACHLORIDE VAPOUR MIXTURES ON SEVERAL NATURAL SULPHIDES, SULPHARSENITES, AND SULPHANTIMONITES.

By K. BRADDOCK-ROGERS.

(The John Harrison Laboratory of the University of Pennsylvania.)

The application of air-carbon tetrachloride vapour mixtures for the decomposition of certain natural and artificial sulphides has been shown in a previous paper (Rogers, *The Chemical News*, 1929, cxxxviii, 147). The present paper is a continuation of the first and it gives the optimum conditions for the decomposition of galena, chalcocite, covellite, arsenopyrite, enargite, cobaltite, tetrahedrite, jamesonite, and bournonite and the subsequent estimation of their sulphur content.

With two exceptions the apparatus, reagents, and the procedure were the same as have been described. The quantity of ammoniacal hydrogen peroxide in each absorber was reduced from 75 ccs. to 60 ccs. The carbon tetrachloride which was used in these analyses showed no trace of sulphur compounds when it was tested in the manner already described. Four distinct tests were made on the sample and this was the only sample of seven, from several different manufacturers, which did not show sulphur compounds to be present. To avoid unnecessary repetition and needless consumption of space the reader is referred to the first paper for full details of the method.

THE SULPHIDES.

GALENA.

The decomposition of this mineral proceeded very smoothly. The mineral was heated at 300-325° C. for forty-five minutes. A slightly higher temperatnre might be used, but this is not advisable as the lead chloride formed had a tendency to sinter together and retard the decomposition. The contents of the boat dissolved away from the gangue very readily in boiling water. The volatile chlorides in the tube were washed into the main solution (q.v.). The temperature of the carbon tetrachloride vapour generator was 55-60° C.

Weight of Mineral.	Sulphur
.8257 gm.	13.41 per cent.
.2189 gm.	13.45 ,, ,,
.2157 gm.	13.38 ,, ,,
Average	13.41 ,, ,,

CHALCOCITE.

The decomposition of this mineral presented no difficulties. The mineral was heated for about fifteen minutes at 300-325° C. and then for fifteen to twenty minutes at 500-525° C.; total time, thirty-five to forty miuntes. The contents of the boat were readily leached from the gangue and these chlorides together with the volatile chlorides in the tube were added to the main solution. The temperature of the carbon tetrachloride vapour generator was 45-50° C.

Weight of Mineral.	Sulphur.
.2894 gm.	19.36 per cent.
.3286 gm.	19.32 ,, ,,
Average.........	19.34 ,, ,,

COVELLITE.

As was to be expected from the previous work on copper matte, nickel matte, and chalcopyrite the initial stages of the decomposition of this mineral tended to proceed with too great a velocity. The carbon tetrachloride vapour generator warmed to 25-30° C. and the mineral was heated for fifteen minutes at 275-300° C. After this initial heating the decomposition was completed at 500-525° C. The total time for the completion of this reaction was forty to forty-five minutes. The chlorides in the boat and in the tube were washed into the main solution.

Weight of Mineral.	Sulphur.
.2876 gm.	30.14 per cent.
.2872 gm.	30.12 ,, ,,
.2858 gm.	30.05 ,, ,,
Average.........	30.10 ,, ,,

THE SULPHARSENITES.

ARSENOPYRITE.

The decomposition of this mineral proceeded very smoothly and afforded one of the best examples of the application of air carbon tetrachloride vapour mixtures for the decomposition of the sulphur bearing minerals.

The mineral was heated for thirty-five minutes at 450-460° C. Everything sublimed from the boat except the gangue. The temperature of the carbon tetrachloride vapour generator was 50-55° C.

Weight of Mineral.	Sulphur.
.3142 gm.	19.27 per cent.
.3096 gm.	19.34 ,, ,,
Average.........	19.30 ,, ,,

ENARGITE.

Once again the presence of copper sulphide had a tendency to cause the decomposition of the substance to proceed too rapidly. Accordingly the sample was warmed for twenty minutes at 200-225° C. and for a second twenty-minute interval at 300-325° C. Everything went into solntion with warm water except the gangue. The temperature of the carbon tetrachloride vapour generator was 40.45° C.

Weight of Mineral.	Sulphur.
.3025 gm.	29.45 per cent.
.2963 gm.	29.55 ,, ,,
.3050 gm.	29.53 ,, ,,
Average.........	29.51 ,, ,,

COBALTITE.

This mineral was mixed with ferro-cobaltite and much gangue material. The sample was heated for ten minutes at 325-340° C., and then for one-half hour at 540-560° C. A small part of the cobalt chloride sublimed from the boat and the remainder was dissolved from the gangue with hot water. The temperature of the carbon tetrachloride vapour generator was 45-50° C.

Weight of Mineral.	Sulphur.
.3047 gm.	15.96 per cent.
.3073 gm.	15.91 ,, ,,
Average.........	15.93 ,, ,,

THE SULPHANTIMONITES.

The decomposition of the sulphantimonites with chlorine gas has always been objectionable. More chlorine than is desirable is usually made, which must be disposed of in some way. This gas is forced through the system, seldom drawn through it, and this is always conductive to loss, especially with such a corrosive substance as chlorine. The decomposition with chlorine requires the closest attention of the operator to insure success. On the other hand, when an air carbon tetrachloride vapour mixture is used, the reverse is true. When the decomposition is finished, the reacting gases may be stopped immediately and then there is no residual obnoxious gas to remove. The active agents are always drawn through the system, reducing loss by leakage to a minimum. Furthermore when the decomposition is once under way the operator may leave it and only glance at it occasionally.

TETRAHEDRITE.

The mineral was readily and easily decomposed by an air carbon tetrachloride vapour mixture. The mineral was not heated for a half-hour, as the decomposition was effected by the hot gases. After this the mineral was warmed for ten to fifteen minutes at 250-300° C. The temperature of the carbon tetrachloride vapour generator was 45-50° C. The volatile chlorides were washed from the decomposition tube into the main solution by a hydrochloric acid-bromine mixture prepared as described. The hydrochloric

acid-bromine mixture in the absorber A contained three grams of tartaric acid.

In addition to the normal constituents, this mineral contained considerable silver and lead, as well as arsenic, bismuth, mercury, and iron. It was advisable to treat the contents of the boat separately, so that the gangue and the silver chloride were removed together, and all of the lead could also be kept from the main solution.

Weight of Mineral.	Sulphur.
.3072 gm.	21.71 per cent.
.3008 gm.	21.71 ,, ,,
Average.........	21.71 ,, ,,

JAMESONITE.

The conditions for the decomposition of this mineral were identical with those for tetrahedrite.

Weight of Mineral.	Sulphur.
.3000 gm.	21.46 per cent.
.3000 gm.	21.29 ,, ,,
Average.........	21.38 ,, ,,

BOURNONITE.

The mineral was warmed at 225-250° C. throughout the decomposition. In all other respects the conditions were the same as those for tetrahedrite.

Weight of Mineral.	Sulphur.
.3086 gm.	12.62 per cent.
3.041 gm.	12.62 ,, ,,
Average.........	12.62 ,, ,,

DULL LUSTRE VISCOSE.

Writing in the current issue of the *Rayon Record*, a contributor says :

" The recent announcement that Courtaulds are taking steps to protect from infringement a number of patents they hold covering processes for the production of dull lustre viscose yarns has again attracted attention to this important section of the rayon industry. The following outline of the methods employed and an indication of the lines along which research is proceeding, therefore, should be of interest.

The degree of lustre may be defined as the ratio of the regularly reflected to the diffusely reflected light, and, further, provided the surface is smooth, the greater the refractive index the greater is the degree of lustre. On the basis of these concepts the methods of reducing lustre fall into an orderly scheme, the main essentials of which are either to produce irregularities on the surface of the fibre or to attain to a certain degree of heterogeneity in the substance of the fibre itself; to particularise, probably the simplest method is that of permitting the material to shrink during the finishing processes, as this increases the curvatures of the reflecting surfaces, and gives an increased diffusion of the reflected light and therefore reduces the lustre. The same result may be attained by increasing the twist of the yarn; this method, however, is attended by certain disadvantages, for it tends to take away the pleasant handle of the silk and substitutes a harsher feel.

It has been proposed in a number of patents (1) to add various substances to the viscose before spinning, such as petroleum jelly, aromatic halides, soaps, organic nitrogen compounds, inorganic salts, etc.; in some cases these substances are allowed to remain in the fibre."

ASKERN COALITE WORKS.

Work is now completed on the first section of the new low temperature carbonisation plant at the pithead of the Askern Colliery, Yorks, and production is expected to begin in the course of the next few weeks.

The plant has been erected for Doncaster Coalite, Ltd., by Low Temperature Carbonisation, Ltd., and arrangements have been made with the Askern Coal and Iron Company for the supply of coal direct from the pit over a period of years.

The plant is being erected in two parts and the portion now completed will have an input of 250 tons of coal per day. This capacity will be doubled when the scheme is completed. The plant will be in continuous operation, day and night. The weekly output is expected to be 1,250 tons of Coalite: 35,000 gallons of coal oil; 4,000 gallons of crude motor spirit ;10 tons of sulphate of ammonia.

In consequence of the widespread demand for smokeless fuel, it has been possible to embrace the Askern output in the contracts which have been arranged between Low Temperature Carbonisation, Ltd., and the coal merchants for the ensuing summer, and as a consequence, the entire output of the works has been sold in advance, right up to next winter.

BOARD OF TRADE ANNOUNCEMENT.

The Treasury have made an Order under Section 10(5) of the Finance Act, 1926, exempting methyl cyclohexanol methyladipate from Key Industry duty from 10 June to 31 December, 1929, and continuing the exemption from date of radium compounds until the same date.

THE HELICOIDAL CLASSIFICATION OF THE ELEMENTS.

By Charles Janet.

[Ever since J. A. R. Newland's first paper on the "Law of Octaves" appeared in the *Chemical News* (1865, xii, 88) many contributors to this Journal have suggested schemes to indicate the periodicity of the elements. A number of the recent ones were summarised by Dr. J. G. F. Druce in the *Chemical News*, 1925, cxxx, 322, and in addition there have been a number of papers by F. H. Loring. The latter has published (*Chemical News*, 1909, xcix, 148) a method of harmonising the Atomic Weights and other properties of the Elements and (in 1922) a Wedge Periodic Table. Mr. Loring has summarised his views in his work, *The Chemical Elements* (Methuen, 8s. 6d.), which may have escaped the attention of M. Janet.—Ed., C.N.]

(*Continued from page 374.*)

The eight groups are—

1 Hydrogen or the Alkalis.
2 Helium or the Alkaline Earths
3 Boron
4 Carbon
5 Nitrogen
6 Oxygen
7 Fluorine
8 Neon.

The number of the group is equal to the number of outer electrons. In the alkaline earths the five elements following helium are Be (4), Mg (12), Ca (20), Sr (38), Ba (56). All are normally bivalent and form compounds of the types,

RH_2
RCl_2
RO
RSO_4

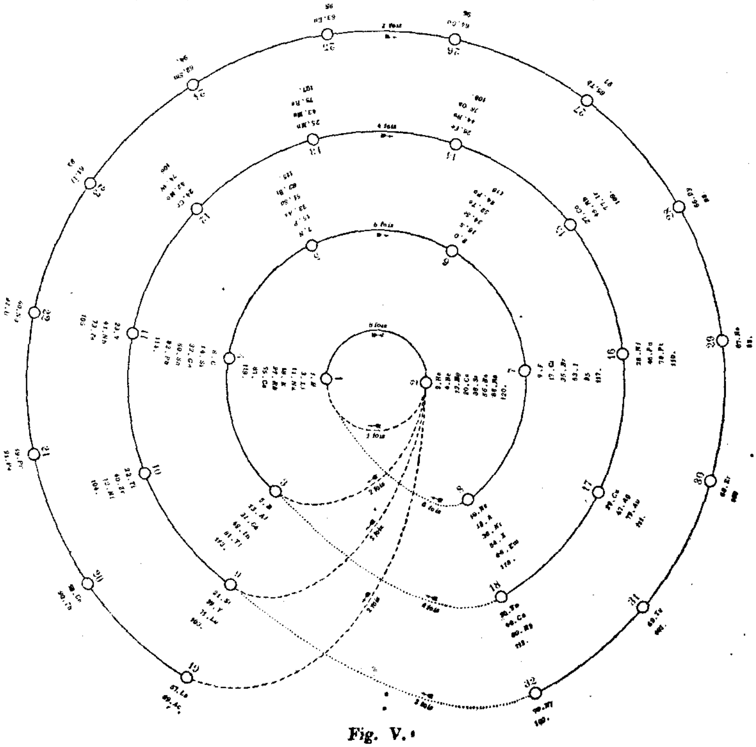


Fig. V.

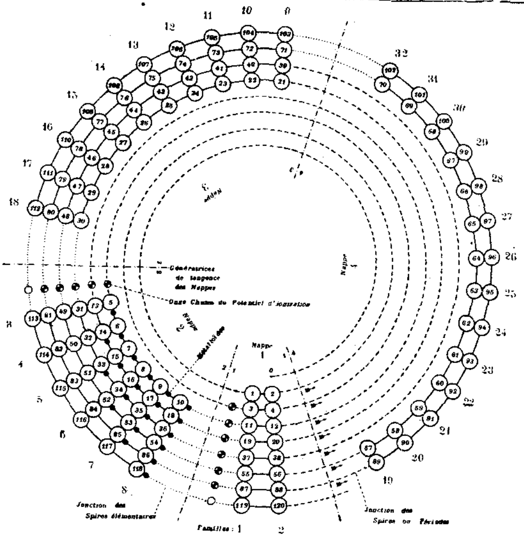


Fig. VI.

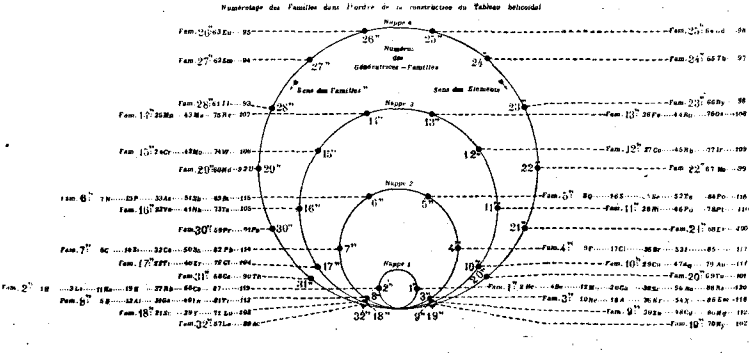


Fig. VII.

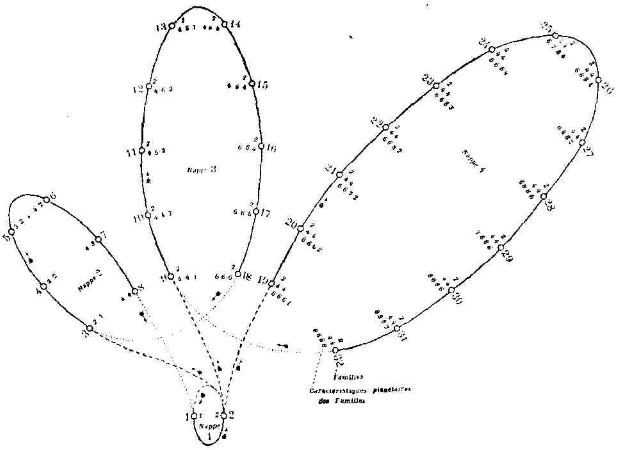


Fig. VIII.

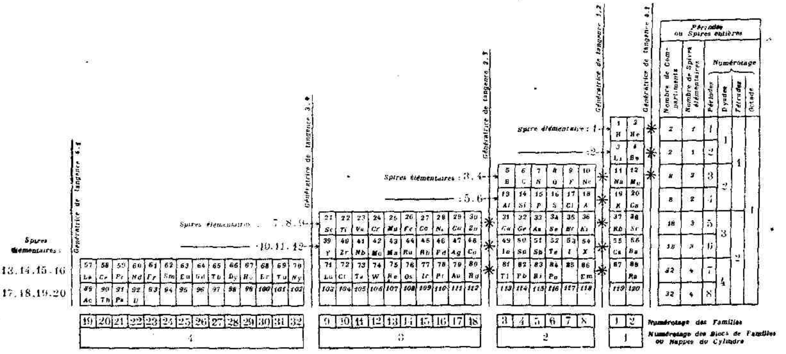


Fig. IX.

The above Table shows the relationship brought out by the oval spirals of Fig. VIII.
Enumeration of the elementary spirals or portions of the periods.

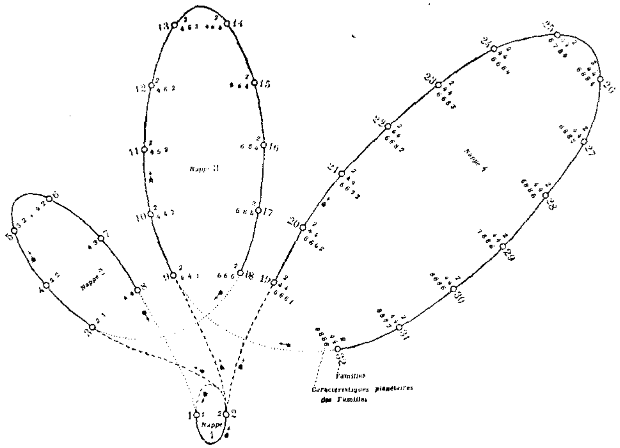


Fig. VIII.

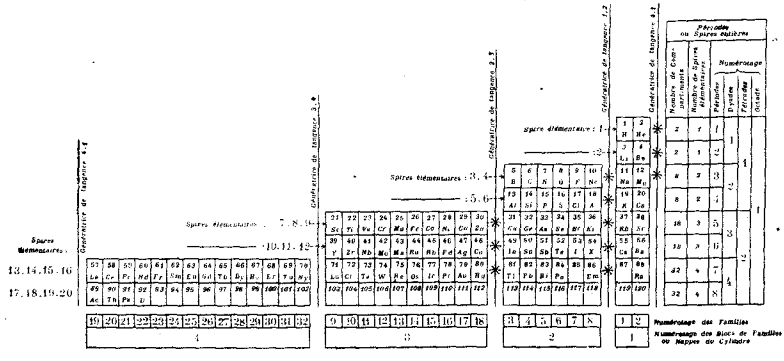


Fig. IX.

The above Table shows the relationship brought out by the oval spirals of Fig. VIII.
Enumeration of the elementary spirals or portions of the periods.

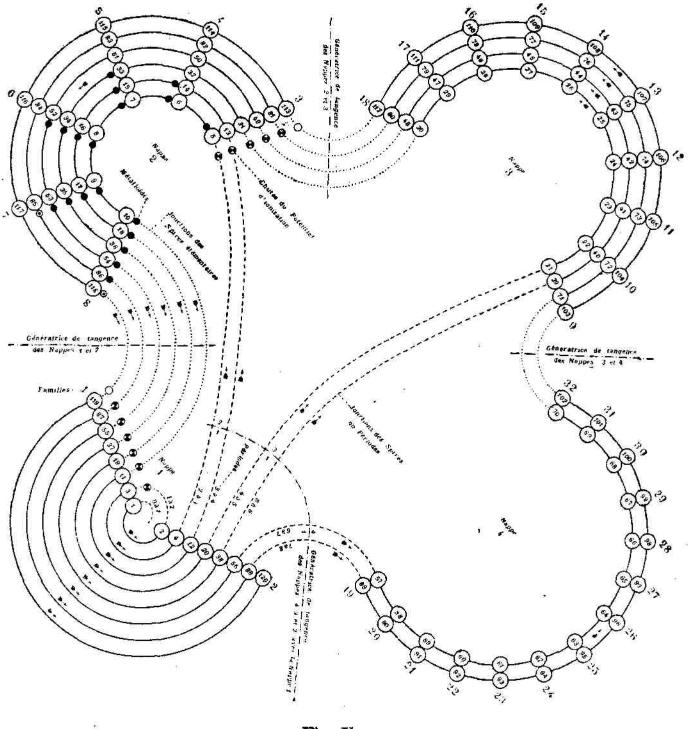
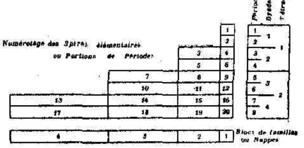


Fig. X.



They ionise in solution and the cation has two positive charges. He and Be, and to some extent Mg, differ from the triad, Ca, Sr, Ba, which again differs markedly from Ra, the last element.

The discovery of **Radium** *followed the* observation of H. Becquerel, 1896, that uranium minerals acted upon a photographic plate. In 1898, Pierre Curie and Mme. Curie discovered Radium in Pitch-

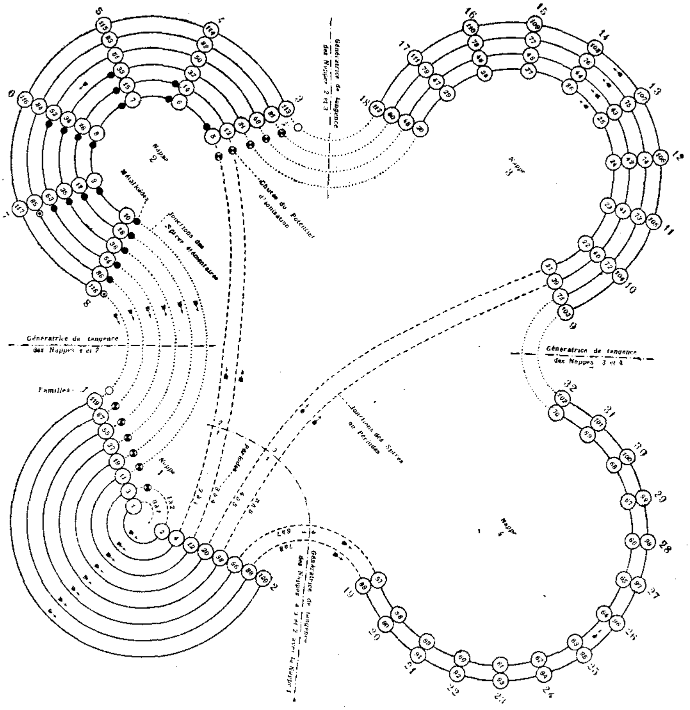
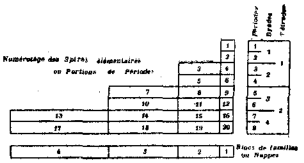


Fig. X.



They ionise in solution and the cation has two positive charges. He and Be, and to some extent Mg, differ from the triad, Ca, Sr, Ba, which again differs markedly from Ra, the last element.

The discovery of **Radium** *followed the* observation of H. Becquerel, 1896, that uranium minerals acted upon a photographic plate. In 1898, Pierre Curie and Mme. Curie discovered **Radium** in Pitch-

blende. A. Cohen (1904) and E. Wedekind (1904) obtained by electrolysis amalgams containing barium and radium, whilst in 1910 A. Debierne obtained, on electrolysis of radium which gave on distilling a residue of radium in the metallic state. This metal is more volatile than barium and reacts vigorously with nitrogen.

An eighth element, the hypothetical Eka-Radium, of atomic number 120, completes the group as in indicated by the helicoidal representation. The series of atomic numbers, N, is given by

$$n+2(1^2+2^2+2^2+3^2+3^2+4^2+4^2)$$

i.e., 2, 4, 12, 20, 38, 56, 86, 120, corresponding with He, 2. Be, 4. Mg, 12. Ca, 20. Sr, 38. Ba, 56. Ra, 88. Eka-Ra, 120.

The Helicoidal Table constructed in columns for the groups is shown in Fig. III. This scheme brings ous both horizontal groups and vertical groups. The former are twenty portions of periods corresponding with 20 elementary spirals. Eight periods corresponding with eight entire spirals. Four dyads of periods corresponding with four dyads of spirals. Two tetrads of periods corresponding with two tetrads of spirals.

The vertical groups are thirty-two families in four blocks corresponding with four surfaces of cylinders, two dyads of blocks of families corresponding with the surfaces of two cylinders. The Helicoidal Table thus shows a complete arithmetical regularity.

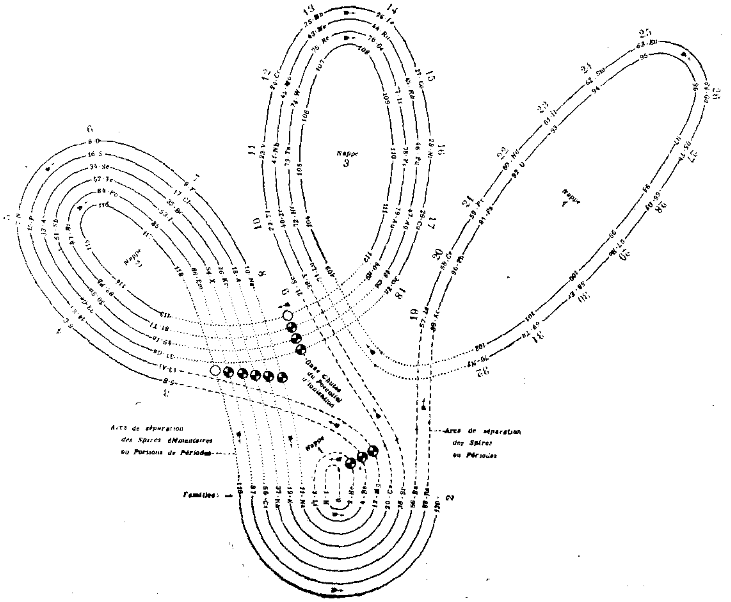


Fig. XI.

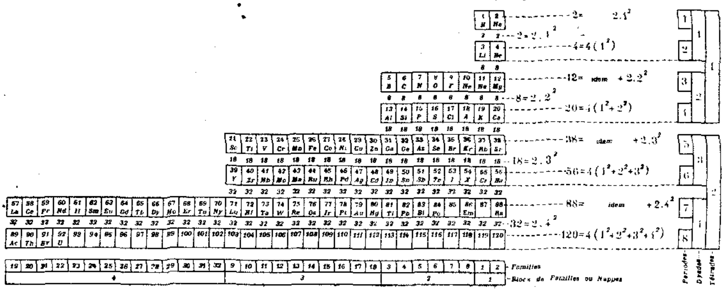


Fig. XII.

To construct the helix from the series of elements prolonged to that (hypothetical) one of atomic number 120 the series is represented by a line as in Fig. IV, and when wound round a cylinder gives the form of a figure 18, Fig. II.

When projected into the form of four circumferences of circles possessing a common tangential point and so representing the surfaces of four cylinders, the result is as shown in Fig. VII.

Actually the circles should be spirals as is indicated in Fig. V.

If the groups of families are placed in an arrangement of ovals the four groups appear as shown in Fig. VIII. Each one, however, needs amplifying to bring in all the elements and this is indicated in the open spiral scheme with 8, 6, 4, and 2 elementary spirals attached respectively for each of the sections.

Another way of showing this arrangement is given in Fig. IX, where the lines are uncrossed. The four important divisions of the elements can be indicated equally well without all these sinuosites. They can be marked as in Fig. X by dotted lines to correspond with the spiral given in the earlier figures. A similar result is obtained in the wedge Table of Fig. XI.

GENERAL NOTES.

PERCENTAGE INCREASE IN ECONOMIC ACTIVITY IN CANADA, 1926-1928.

	Canada. %	U.S. %
Index of Industrial Production	12	2
Employment (all industries) ...	20	6*
Steel Production	58	6
Construction Contracts	25	5
Railway Operating Revenue ...	14	4*
Carloadings	17	3*
Foreign Trade	13	0.2*
Hydro-Electric power gener't'd	49	19
Petroleum Consumption	50	16

* Decrease.

Steel production has expanded much more rapidly in Canada than in the United States due to extensive railway development and large construction programmes. — *Royal Bank of Canada (Montreal).*

OVERSEAS TRADE.

His Majesty's Consul at Osaka (Mr. M. Paske-Smith) reports that a local firm of enamelware manufacturers desire to be placed in touch with United Kingdom manufacturers and suppliers of the undermentioned requirements :—

(*a*) Aluminium oxide, cobalt oxides, antimony oxide, zinc oxide, chromium oxide, zilican oxide, borax and colouring matter for use in making enamel goods.

(*b*) Enamelling sheets.

(*c*) Furnaces, specifying where necessary the kind of fuel used.

(*d*) Automatic machinery for making enamelware.

Firms desirous of offering British products can obtain further particulars of this enquiry upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference B.X. 5388 should be quoted.

DETERMINATION OF ZINC OXIDE IN PAINTS.

By Edward J. Davis, Ch.E., Research Chemist, Coheen Corporation of New Jersey, Paint Engineers.

The following method, devised by the writer, is the only method of estimating ZnO accurately in the presence of lithopone (Zn S Ba SO_4). Besides being accurate the method is rapid and simple, the old method being more tedious and giving very doubtful results. Because of the frequency of occurrence of ZnO with lithopone in paints, the method is of no small practical importance. Besides the ZnO lithopone combination, the ZnO may be estimated equally as well in all other combinations in paint.

The method depends on the solubility of ZnO in a fairly concentrated solution of NH_4Cl in the presence of NH_4OS. All other paint pigments are insoluble in this solution.

Take a 1 gm. sample of suitably extracted pigment, and then add 50 cc. of a saturated solution of NH_4Cl, together with 35 cc. of concentrated NH_4OH. Boil five minutes and filter. After washing with hot water containing NH_4Cl, test the residue on the filter paper for Zn, and if none is present, dilute the filtrate and washings to 400 cc. Acidify and titrate with ferrocyanide as directed under the ordinary volumetric procedure for zinc.

The entire determination may be run in 20 minutes, whereas the old method required waiting over-night for results. The method has been repeatedly checked and found accurate to within ± 0.1 per cent.

REFORM OF THE PATENT LAW.

Report by the General Council of the Bar.

The proposals for reform of the British Patent System recently put forward by the British Science Guild have been reviewed by a Committee of the Bar Council the members of which included, amongst others, Sir Duncan Kerly, K.C. (chairman), Mr. James Whiteread, K.C., the Hon. Stafford Cripps, K.C., and Mr. Trevor Watson.

The views of this Committee, which were arrived at after minute examination of the Report of the British Science Guild are of particular interest in view of the recent appointment by the Board of Trade of a departmental committee under the chairmanship of Sir Charles (formerly Lord Justice) Sargant, to consider the same subject.

The Bar Council warmly commend the Report of the British Science Guild, which was the work of a Committee whose Chairman was Dr. W. H. Eccles, F.R.S., and whose Honorary Secretary was Capt. C. W. Hume; they consider that most of the proposals of the Report are reasonable and likely to be useful.

Commenting on some particular points, they express the view that a patent ought not to be invalidated by mere "Paper" anticipations—that is, by the publication many years ogo of ideas which were still-born and have never become known to the trade. They agree that there should be stronger remedies against unwarranted threats by which persons wrongly claiming to possess patent rights may seek to prejudice rival manufacturers, and they also support the proposal that appeals from the decisions of the Comptroller of the Patent Office should be heard by a special judge in chambers instead of by the Attorney-General or Solicitor-General as at present.

COMMEMORATION DAY AT LIVINGSTONE COLLEGE.

A very successful day was held on Wednesday, June 5, at Livingstone College, Leyton. The Right Rev. the Lord Bishop of Chelmsford presided over a large gathering. He said he was glad to be present because Livingstone College stands for missionary work, and he had been taught from his earliest years and still believes that that is one of the primary duties of every Christian person. "The things for which Livingstone College stands," he said, "are so fundamental tLat we want to insist upon them in all our missionary work at the present time. It stands for the need for instructing missionaries in the elements of medical law, in the first place in order that they may take care of themselves, and that they may be a real help and blessing to the people to whom they are going in helping them in their time of physical need. . . Our Lord's method, as we are continually reminded, was to reach people through the needs of their bodies; men and women cried out for help in deliverance from the maladies with which they were afflicted, and He was able to relieve them and point them to higher things. It is exactly the same in the world to-day; people have the same bodily needs and they look to the Missionary for help.

BUSY CANADIAN IRON AND STEEL INDUSTRY.

According to the Dominion Bureau of Statistics at Ottawa, the total production of pig iron during the first four months of this year amounted to 347,220 long tons, as compared with 282,823 tons for the corresponding period of 1928; with 255,289 tons for a similar period of 1927; and with 227,248 tons for the same months in 1926.

Steel production has also reached a similar high level, the figures for the four months being 492,965 long tons, as compared with the corresponding total for 1928 (four months) of 414,153 tons; for 1927, 330,659 tons; and for 1926, 260,394 tons.

April production both of iron and steel was less than the output in March, but represented an increase as compared with the figure for April, 1928. The April production of pig iron amounting to 79,341 long tons was the lowest reached during the current year to date, being 8 per cent. less than the 86,176 tons produced in March, but 6 per cent. more than the 74,736 tons reported in April, 1928. Steel production of 122,102 tons in April was the second highest output reported since 1918, being only exceeded in the next preceding month when the tonnage was reported at 137,158 tons.

Production of ferro-alloys in Canada in four months of this year totalled 23,981 tons, an increase of 35 per cent. as compared with the 17,808 tons reported for the four months ending April, 1928.

FLYING FOX PROBLEM IN AUSTRALIA.

A most serious menace confronting fruit-growers in Queensland and New South Wales is that of the large fruit-eating bats commonly known as flying foxes. There are five species in Australia, the commonest by far being *Pteropus poliocephalus*. The animals are nocturnal in habit and very gregarious living in "camps" of hundreds of thousands of individuals.

The comparative failure of obvious methods of control such as shooting, poisoning, etc., was mentioned in a report of the Council for Scientific and Industrial Research. It has now been decided to approach the problem from a fundamental basis and to collect further details concerning the biology of the animal. In order that a full study may be made of all sides of the problem, the Council and the Departments of Agriculture of New South Wales and Queensland have agreed to contribute £500 each towards the cost involved. Applications have been called for an investigator to carry out the work at a salary of £600 per annum for two years. The appointee will be expected to make a systematic biological study of those species of flying fox which are a pest in certain parts of Australia, and he will also be required to seek quantitative evidence as to the ravages of the animal and obtain as accurate an estimate as possible of the losses it is causing to fruit and other industries in New South Wales and Queensland. The ultimate object of the whole investigation will be the attainment of a satisfactory method for large scale destruction of this serious pest.

THE MANUFACTURE OF SULPHURIC ACID IN CANADA.

According to a recent news item a large plant is shortly to be established in northern Ontario for the maunfacture of sulphuric acid from smelter fumes. In this connection it is of interest to note that during the year 1928 Canadian sulphuric acid plants produced 96,227 tons of 60 degrees Baumé sulphuric acid valued at $1,077,836, as against 98,470 tons worth $1,172,507 in 1927. Exports of sulphuric acid from Canada amounted to 13,329 tons worth $152,544 in 1928 as against 17,407 tons worth $191,926 in the previous year; practically all of the acid was shipped to the United States. Imports totalled only 55 tons worth $8,652 in 1928 and 53 tons at $8,548 in 1927.

Six Canadian plants used 18,494 tons of pyrites and 18,851 tons of brimstone, while one of them owned by the Mond Nickel Company made sulphuric acid from waste smelter gas.

COMMONWEALTH OF AUSTRALIA.—COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

Second Annual Report, for Period Ended 30 June, 1928.

We have received the second Annual Report of the above very useful body and have pleasure in publishing extracts therefrom :—

The progress that has been made in the various activities of the Council during the last twelve months relates, in the main, to the planning and organisation of investigational work and to the collection of the necessary personnel and apparatus. Some progress in actual investigational work has

been made and important results of no little economic value have been obtained, but, as is only to be expected, these have been chiefly confined to the investigations that have been in progress over a period of years and passed on to the Council by its predecessors. As regards investigational work recently initiated, the experience obtained in other countries, that the gathering together of a comprehensive research organisation is a matter of several years, and that research generally reduces to the slow systematic expansion of knowledge with here and there a rapid, illuminating, and valuable acceleration of progress, has been abundantly confirmed. The chief work of the year has been the creation of the nucleus of a strong and effective organisation which, in the next two or three years, will provide for Australia a research institution capable. in co-operation with existing institutions, of solving many of the pressing national problems that now are so evident.

In the report, information is given as to what has been done and what it is proposed to do. Investigational work and results are not discussed in detail, as information of that nature is given in the various publications of the Council, namely, its bulletins, pamphlets and quarterly Journal.

I. *The Council.* — Since the previous report was made two meetings of the full Council have been held, the first in December, 1927, and the second in April, 1928. Unless special circumstances arise it is probable that in future two meetings will be held each year, of which the first will be sufficiently early to allow of consideration of draft estimates of expenditure for the following financial year. The Council meetings that have been held to date have each extended over three days.

Liaison with Scientific Organisations in Other Countries.—An important function of the Council is that of acting as a means of liaison between the Commonwealth and other countries in matters of scientific research. Further progress in establishing the necessary relations with these bodies has been made.

In Great Britain, scientific research on national problems falls into two main classes, namely, that connected with the agricultural industry and that connected with the secondary industries. Research work in the former category is subsidised on an extensive scale by the Development Commissioners, the actual work being carried out by independent organisations such as the Rothamsted Experiment Station for soils work and the growth of plants, the Rowett Research Institute for animal nutrition, the East Malling Research Station for horticulture, etc., each Institute specialising in a particular aspect of agricultural problems. With many of these organisations touch has already been established and all have been particularly ready to afford the Council their help, both in the direction of furnishing advice on particular problems and in making the results of their own research work freely available. In addition, in several instances, arrangements have been made for the British organisation to house an Australian investigator for a period sufficient to enable him to obtain full information as to the methods of research adopted, and experience in details of technique, etc. There is no doubt whatever that this help will be of considerable value to the Australian agricultural and pastoral industries in the future.

The research needs of the secondary industries of Great Britain are chiefly the concern of the British Department for Scientific and Industrial Research, and, in general, the Department's main activities relate to those industries. Here, again, the relations that have been established between the Council and the Department are proving most valuable. The major investigations of the Department of most interest to Australia are those of its National Physical Laboratory and its Boards dealing with researches in fuels, forest products and the preservation of foods.

ARCHITECTURAL TERRA-COTTA AND FAIENCE.

Investigations on the weathering properties of terra-cotta, undertaken by the Building Research Station of the Department of Scientific and Industrial Research during the years 1926-28, in co-operation with the Terra-Cotta Association, are the subject of a Report just issued.

As a fundamental knowledge of clays, raw or burnt, does not exist, it was only possible within the time limit placed on the investigation to measure differences in physical properties between the specimens which weather well and those which do not, and to consider briefly processes of manufacture. From the details of the study given in the Report, however, several definite points have emerged which suggest the reasonable possibility of enunciating tests which could be applied to the finished ware in order to detect good and bad varieties.

The Report includes not only a short history of architectural terra-cotta, but also an introductory chapter on the processes of the manufacture.

IMMENSE AMBER DEPOSITS IN MANITOBA.

The Financial Post (Toronto) of May 6 contains an article by Janet Munro setting forth some of the facts in regard to the submerged forest which is believed to exist under Cedar Lake, an extension of the Saskatchewan River, near to the point at which it enters Lake Winnipeg.

From time immemorial Indians have gathered amber along the shore of Cedar Lake. Some of the pieces found are as large as robins' eggs and they are from pale yellow to dark brown in colour. In one area, 10 per cent. of the material of the beach is stated to be made up of amber, reports having been made there between 50 and 60 years ago. At that time the exploitation of the amber deposits derived from this submerged forest was considered to be impossible in view of the difficulty of transporting machinery to the spot.

With the construction of the Hudson Bay Railway and of other methods of communication into this neighbourhood, it is believed that exploitation of these resources may be practicable, though the difficulty of mining in water presents a problem which has not yet been competely solved.

THE ALUMINIUM PRODUCTS INDUSTRY IN CANADA, 1928.

The Dominion Bureau of Statistics at Ottawa has forwarded to the High Commissioner of Canada in London a report indicating that the production of Aluminum manufactures in Canada (except smelter products) was valued at $3,192,696 in 1928. This output marked a new high level for the industry, being 38 per cent. above the total of $2,318,894 for 1927. Fourteen plants, all in Ontario, manufactured aluminium articles in 1928. The capital employed by these concerns amounted to $5,094,218 and the average number of employees was 609. Kitchenware of all kinds was made in 9 different factories and 7 of these made kitchen utensils only.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Papers read on Thursday, June 13 :—

The Scattering Theory of the Effect of Glare on the Brightness Difference Threshold. By W. S. STILES. Communicated by Sir John Parsons, F.R.S.

The theory that the observed increase in the threshold due to the presence of a glare source in the field, is caused by light scattered in the eye media, is formulated mathematically, using Rayleigh's scattering formula, and taking into account variations in the pupil area.

Reciprocal Contraction of Antagonistic Muscles in Peripheral Preparations—Using Flashing Neon Lamp Circuit for Excitation of Nerve. By GRACE BRISCOE AND WINIFRED LEYSHON. Communicated by Sir Charles Sherrington, F.R.S. (Illustrated by cinematograph film.)

It has been shown previously by one of the authors that all types of respiratory movement and different degrees of postural tone in the diaphragm can be accurately reproduced by varying the amplitude of a faradic stimulus. It is here shown for the first time that reciprocal contraction of antagonistic muscles can be obtained in peripheral preparations by reciprocal excitation of the nerves of the opposing muscles.

The electrical stimulation has been carried out by utilising the regular intermittent discharges of a condenser in a neon tube flashing circuit. These discharges are passed either (*a*) through a primary coil oscillating between two secondary coils, or (*b*) through an arrangement of potential dividers, one of which consists of a conducting fluid into which dips an oscillating wire. By either of these methods reciprocal changes in the stimuli can be obtained.

Critical Temperature of Freezing—Living Muscle. By T. MORAN. Communicated by Sir William Hardy, F.R.S.

The Formation of Lactic Acid in Muscles in the Frozen State. By E. C. SMITH. Communicated by Sir William Hardy, F.R.S.

A normal muscle with adequate supply of oxygen is in a steady state, in which rate of production of lactic acid and of its removal are so balanced that the percentage of acid present keeps at a very low constant level. Freezing (that is, drying) upsets this balance, making production exceed removal,

This upset is due to, or accompanied by, injury to the mechanism, but in a storage of 24 hours at temperatures between freezing-point and -1.6° C. the mechanism of removal is not destroyed, so that on thawing the accumulated acid is removed. Below -1.6° C., the mechanism of removal is destroyed, that of production persisting.

Chromosome Linkage in Oenothera, with Special Reference to Some F_1 *Hybrids.* By F. M. L. SHEFFIELD. Communicated by Sir John Farmer, F.R.S.

Meiosis was studies in pollen mother-cell of F_1 hybrids of Oenothera. At diakenesis some or all chromosomes fail to pair and remain joined end-to-end, forming large rings. They remain attcahed till anaphase, when adjoining chromosomes pass to opposite poles of spindle, any pairs cut off assorting independently. Amount of pairing and chromosome linkage is constant in each hybrid.

Most results can be brought into line with Cleland's hypothesis — absence of pairing due to lack of harmony between homologues. It is suggested that chromosome linkage may be inherited as a genetic character.

A New Thermopile for the Measurement of Nerve Heat-Production. By A. C. DOWNING AND A. V. HILL, F.R.S.

A new type of thermopile was described, for the measurement of heat-production in stimulated nerve, which has the following advantages as compared with previous instruments :—

It gives about twice the E.M.F. per 1° C.; loses heat appreciably less rapidly; "settles down" in about one-third of the time and has a more constant "zero."

The Heat-Production and Recovery of Crustacean Nerve. By A. V. HILL, F.R.S.

THE PHYSICAL SOCIETY.

Papers read on Friday, June 14 :—

Pressure Shifts in Line Spectra of Gases. By W. E. PRETTY, A.R.C.S., D.I.C., B.Sc.

The shifting of certain lines in the spectrum of N_{II} caused by a change in pressure of the gas in the discharge tube has been investigated. Over 80 lines within the region λ 6800 - λ 1850 have been found to shift, and the amount of shift for most of these lines has been determined. The shift is in all cases in the direction of increasing wave-length. The shifts have been discussed in relation to the terms giving rise to the lines concerned and the results have facilitated the identification of three new singlet terms. An enquiry into the nature of the effect leads to the conclusion that it is in the main a stark effect.

The Zeeman Effect for the Arc Spectrum of Gold. By A. S. M. SYMONS, A.R.C.S., D.I.C., B.Sc., AND J. DALEY, A.R.C.S., D.I.C., B.Sc.

The Zeeman effect for about 50 gold lines has been observed and recorded. The field strength used was about 23,000 gauss. A former assignment of terms to the Au I spectrum by McLennan and McLay has been verified to some extent, but certain modifications have been suggested. Suggestions have also been made as to the identity of a few terms which were not previously identified.

The Band Spectrum of Lanthanum Monoxide. By W. JEVONS, D.Sc., F.Inst.P.

The spectrum has been observed from λ 8700 to λ 2850, and the band-heads (most of them not hitherto recorded) arranged into several systems. While the work was in progress Auerbach gave high dispersion data for some of the new infra-red heads, and Mecke briefly reported the analysis of seven systems, having o, o bands at (1) λ 4372; (2) λ 4418; (3) λ 5600; (4) λ 7380; (5) λ 7404; (6) λ 7877; and (7) λ 7910. Mecke concluded that (*a*) systems (3), (5) and (7) have a common final state; (*b*) so have systems (1) and (2); and (*c*) the initial states for (1) and (2) appear to be the final states for (4) and (6) respectively.

Demonstrations were given by G. D. Preston, B.A., of the National Physical Laboratory, showing—

(a) The Crystal Structure of the Allotropes of Manganese; and (b) The Change of Physical Properties during the Age-hardening of Aluminium Alloys.

NOTICES OF BOOKS.

The Chemists' Year Book, 1929. Edited by F. W. ATACK, assisted by R. T. ELWORTHY (American data in collaboration with FRANCIS M. TURNER). Pp. 1188. Manchester : Sherratt and Hughes.

It is noteworthy that this volume which contains such a unique mass of chemical and scientific data should re-appear under a revised form annually and still find new readers. Not only are minor alterations

made, new facts included and the matter generally brought up-to-date but, when necessary, whole sections are re-written in the light of newer knowledge. Thus the section on Gas Analysis has been considerably revised in the new 1929 edition and Messrs. G .D. Elsdon and J. R. Stubbs have collaborated in re-writing the section on Dairy Chemistry. As is inevitable in a work of this size there are still one or two slips which will doubtless be remedied in subsequent issues. The value of the Chemists' Year Book cannot be over-estimated.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, June 26, at 4 p.m.—Annual General Meeting.

GEOLOGICAL SOCIETY.

Wednesday, June 26.—" The Geology of the District around Abbey-Cwmhir (Radnorshire)." By R. O. Roberts, M.Sc. Communicated by Prof. W. J. Pugh, O.B.E., D.Sc., F.G.S. " The Geology of the Country around Bodfean (South-Western Carnarvonshire)." By C. A. Matley, D.Sc., F.G.S., and Albert Heard, Ph.D., M.Sc., F.G.S. " The Petrography of the Borrowdale Series of the Kentmere District." By George Hoole Mitchell, M.Sc., Ph.D., F.G.S.

THE ROYAL SOCIETY.

Thursday, June 27, at 4.30 p.m.—The following papers will be read :—

" A Photoelectric Method of Measuring the Light of the Night Sky; with Studies of the Course of Variation through the Night." By Lord Rayleigh, F.R.S.

" The Action of High Speed Cathode Rays on Acetylene." By J. C. McLennan, F.R.S., M. W. Perrin and H. J. C. Ireton.

" Further Studies in the Emission of Electrons from Cold Metals." By T. E. Stern, B. S. Gosling and R. H. Fowler, F.R.S.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

16,470.—Bataafsche Petroleum Maatschappij. — Manufacture of butyl alcohol. May 28.

16,719.—Bataafsche Petroleum Maatschappij.—Cracking hydrocarbons. May 30.

16,909, 16,910.—Holt, F., and Imperial Chemical Industries.—Manufacture of benzole chloride. June 1.

16,244.—Imperial Chemical Industries, Ltd.—Production of concentrated caustic alkalies. May 27.

16,338.—Imperial Chemical Industries, Ltd.—Nitrocellulose. May 27.

Specifications Published.

312,245.—Elkington, H. D. (Kramer, G. A.)—Manufacture of motor fuels.

290,265.—Raffinerie Tirlemontoise Soc. Anon.—Treatment of saccharate scums.

285,838.—Schering-Kahlbaum Akt.-Ges.—Process for the manufacture of thymol.

312,512.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges)—Process for the purification of synthetic butyl alcohol.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

309,734.—Chemical processes, furnaces.—Vetterlein, R., 11, Ludwig Rudolfstrasse, Blankenberg, Harz, Germany.

Reactions between neutral or acid salts and liquid reagents, *e.g.*, between chlorides and sulphuric acid in the production of sulphates and bisulphates, are effected in a superposed hearth furnace of the kind used for roasting ores, the charge being directly heated in counter current with the combustion products. The solid material is fed on

to a plate carried by the rabble shaft, from which it falls on to the uppermost hearth of the furnace, while the liquid reagent is preferably supplied through a conduit in the shaft delivering at a point below the plate. The use of the process for the production of soda and for purely metallurgical purposes is disclaimed.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

TOMACO.

502,139.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—W. Thomas & Company, Limited, 1, 2 & 3, Eastern Parade, Eastern Avenue, Ilford, Essex. May 29th.

PLANEDRIN.

501,775.—Chemical substances prepared for use in medicine and pharmacy.—May & Baker, Limited, Garden Wharf, Church Road, Battersea, London, S.W.11. June 5th.

PLUSPIRIN.

501,979.—Chemical substances prepared for use in medicine and pharmacy.—Gordon Allan Dunbar, 75, Seymour Street, Marble Arch, London, W.2. June 5.

PERIMCO.

502,130.—Chemical substances used for agricultural, veterinary, horticultural and sanitary purposes.—The Cyona Company, Limited, Aston, Wallingford, Berkshire. June 5.

KEK.

501,937.—Chemical substances used in photography and photographic films (sensitised).—F. W. Hampshire & Company (1927) Limited, Sunnydale Works, Sinfin Lane, Derby. June 5.

"CHEMICAL NEWS"—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, "CHEMICAL NEWS,".
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices: MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. *It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.*

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices: MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

URGENTLY WANTED

TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.

also

No. 3400. Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

THE CHEMICAL NEWS

VOL. CXXXVIII. No. 3611.

MERTON HOUSE, SALISBURY SQUARE, LONDON, E.C.4.

TELEPHONES:
Administrative: Central 6521.
Printing Works: Hop 2404.

CONTENTS. PAGE.

The Spectral Adsorption of Certain Monoazo Dyes. The Effect of Position Isomerism on the Spectral Absorption of Methyl Derivatives of Benzeneazophenol 401
By Wallace R. Brode.
The Magic Medicine of the Hottentots 403
By P. W. Laidler, L.R.C.S. & P.
Consumer Credit 406
By J. Gibson Jarvie, Barrister.
Commonwealth of Australia — Council for Scientific and Industrial Research 409
Chemical Industries 408
General Notes 408
Proceedings & Notices of Societies :—
The Royal Society 410
Mineralogical Society 411
Royal Society of Arts 412
The Chemical Society 412
Society of Glass Technology 413
The Chemical Society of Japan 414
The Optical Society 415
Forthcoming Events 415
New Patents 415
New Trade Marks 416

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

THE SPECTRAL ABSORPTION OF CERTAIN MONOAZO DYES. — THE EFFECT OF POSITION ISOMERISM ON THE SPECTRAL ABSORPTION OF METHYL DERIVATIVES OF BENZENEAZOPHENOL.

By WALLACE R. BRODE.

(*Bureau of Standards Research Journal.*)

Quantitative measurements of the spectral absorption of solutions of azobenzene, benzeneazophenol and the mono- and dimethyl derivatives of benzeneazophenol in alcohol, aqueous hydrochloric acid, and aqueous sodium hydroxide are recorded and their relationships discussed. Although the differences found in the spectral absorption of alcohol solutions or of hydrochloric acid solutions of the position isomers studied are small, marked differences are found in the absorption of 3 per cent. aqueous sodium hydroxide solutions.

OUTLINE OF INVESTIGATION.

Probably no other single physical measurement is so characteristic of an organic compound as its spectral absorption. It is a means of identification and a measure of the purity and amount of the compound in the observed solution. The advantages of spectrophotometric analysis are particularly apparent in the examination of dyestuffs, where colour is an important factor. The high molecular weight of the average commercial dyestuff, together with its complex chemical structure and the presence of organic and inorganic impurities, renders more difficult the determination of either its chemical or its other physical properties.

It is natural, therefore, that the dye laboratory of the Bureau of Standards should include the measurement of spectral absorption among the observations which are being made in connection with the collection of accurate quantitative data on the physical and chemical properties of dyestuffs. Through the co-operation of the colorimetry section of the Bureau of Standards, apparatus is available for the accurate measurement of spectral absorption. This apparatus, to a large extent, eliminates the instrumental and personal errors present in many of the earlier researches in this field.

The present paper is chiefly concerned with the relation between the spectral absorption and chemical constitution of the mono- and dimethyl derivatives of benzeneazophenol, in which but one methyl group is

present in a benzene ring. These dyes have been prepared and purified, and accurate quantitative measurements have been made of their spectral absorption in three solvents. The solvents used were 95 per cent. ethyl alcohol, concentrated hydrochloric acid (35 per cent.), and a 3 per cent. aqueous solution of sodium hydroxide. Since this work deals with only one type of substituting group, the methyl radical, no conclusions can be drawn on the general effect of substitution, and the discussion of the results will necessarily have to be limited to a recapitulation of the data presented without predicting the possible effects of other substituting groups.

In earlier papers data have been presented on the spectral absorption of azobenzene and benzeneazophenol in various solvents, and only such data on these compounds as may be essential to the clarity of the discussion and the correlation of the effects observed will be presented in this paper.

Nomenclature.

The nomenclature recommended in the report of a committee of the Optical Society of America has in large part been followed. Scientific Paper No. 440 and Technologic Paper No. 338 of the Bureau of Standards have also been consulted in drawing up this set of definitions. The terms most used, symbolised by T, t, k, c, b, λ, and f, are few in number, but in order to precisely define them other terms are necessarily given.

The following terms relate to the rectilinear propagation of homogeneous radiant energy through a cell with plane, parallel sides (glass or quartz end plates) perpendicular to the direction of propagation, and containing a substance in homogeneous solution in a solvent:

$T_{sol.}$ = the *transmission* of this cell and its contents and is defined as the ratio of the radiant energy passing the last surface of the cell to that incident on the first surface.

$T_{sov.}$ = the transmission of the same or a duplicate cell containing solvent only.

$T_{sol.}$ = the *transmittance* of the solution contained in the cell and is defined as the ratio of the radiant energy incident on the second inner surface of the cell to that passing the first inner surface.

$T_{sov.}$ = the transmittance of the solvent only.

$T = \frac{T_{sol.}}{T_{sov.}} = \frac{T_{sol.}}{T_{sov.}}$ = the *transmittance* of the dye in solution.

The transmittancy, T, of a dye solution is the quantity obtained from the actual measurements. Since the transmission of the cell containing the solution is always compared with that of a duplicate cell containing the solvent, losses by reflection from the ends of the cell and by absorption by the solvent are compensated. The negative logarithm of the transmittancy, $-\log T$, is a quantity which is a direct measure of the absorption of the dissolved material.

t = *specific transmissivity*; that is, transmittancy reduced to unit conditions as regards thickness and concentration.

b = thickness of the absorbing solution. In the present paper 0.5 cm is taken as the unit of thickness, since all of the solutions reported were measured in a cell of that length.

c = concentration of the dissolved material. A concentration of 1.5×10^{-4} gram molecule per litre of solution has been used as the unit in this paper.

$t = cb\sqrt{T}$. This is an expression of Beer's law.

$k = -\log t = \frac{1}{cb}(-\log T)$ = the specific absorptive index.

The specific absorptive index k is the characteristic quantity for any solution at at any wave length or frequency in the spectrum. As shown above, it is obtained from the observed transmittancy, T, by simply dividing the negative logarithm of this number by the product of the concentration and thickness of the solution measured.

λ = wave length, the unit of which in this paper is the millimicron, $m\mu = 10^{-9}$ m.

ν = frequency, the unit of which in this paper is the fresnel, f = vibrations ÷ seconds × 10^{12}.

Summary.

1. An increase in molecular weight is, in of azobenzene in 95 per cent. ethyl alcohol and in concentrated hydrochloric acid has been measured in the visible and in the ultra-violet to a frequency between 1,250 and 1,450 f.

2. The spectral absorption of solutions of benzenazophenol in 95 per cent. ethyl alcohol, concentrated hydrochloric acid, and a 3 per cent. aqueous solution of sodium hydroxide has been measured in the same regions of the spectrum.

3. The 11 possible mono- and dimethyl derivatives of benzeneazophenol, in which there is but one methyl substitution in a benzene ring, have been prepared, and the

spectral absorption of their solutions in the same solvents in the same regions of the spectrum as in the case of the parent compound, benzeneazophenol, has been measured.

4. The spectral absorption of a solution of benzeneazophenol in a 3 per cent. alcoholic solution of sodium hydroxide has also been measured.

From the data obtained the following generalisations may he made :

1. An increase in folecular weight is, in most instances, accompanied by a decrease in the frequency of the absorption band of these similarly constituted compounds.

2. In any one solvent there appears to be a definite mathematical relationship between the frequencies of the observed bands. In the various solvents used the mathematical relationships between the observed adsorption bands are quite different, indicating a considerable change in the molecular states of the compounds.

3. The introduction of a hydroxyl group into the *p*-position of the azobenzene molecule, forming benzeneazophenol, results, in addition to a decided shift in the frequency of the bands, in an increase in the magnitude and a narrowing of the principal band and a decrease in magnitude and flattening of the other observed bands. This would indicate a shift of the vibrational intensity of the molecule to the frequency of the principal band.

4. Substitution of a methyl group in the p'-position in benzeneazophenol results in an increase in the magnitude of the absorption bands, irrespective of the type of solvent.

5. Substitution of a methyl group in the *o* -position in benzeneazophenol results in a general decrease in the magnitude of the absorption bands.

6. The principal absorption bands of solutions of benzeneazophenol and its methyl derivatives in a 3 per cent. aqueous solution of sodium hydroxide appear to consist of two overlapping bands.

7. The equilibrium which seems to exist between these two components is dependent on the nature of the solvent and the position of the substituting group. An *o*-substitution of the methyl group in the benzeneazophenol molecule causes an increase in the lower frequency component, with a corresponding decrease in the higher frequency component. A m'- or o'- substitution produces a reverse effect, while the equilibrium is not affected by either a m'- or p'- substitution produces a reverse effect, while the equilibrium is not affected by either a m'- or p'- substitution.

The data presented in this paper suggest the possibility of a method of structural analysis for the determination of the position of a substituting group in a complex organic molecule ond a reverse of this process in the prediction of the spectral absorption of a compound of known structure. Additional data on the effect of substituting groups, including those of nitro, chlorine, bromine, carboxy, and sulphonic acid substitutions, are now being colleeted with this object in view.

Fundamental data have been presented on the relation between spectral absorption and chemical constitution.

Acknowledgment is made to W. D. Appel, of the dye laboratory of the chemistry division, for his assistance and advice in this work.

THE MAGIC MEDICINE OF THE HOTTENTOTS.

By P. W. Laidler, L.R.C.S & P., D.P.H., F.S.A. (Scot.),

Medical Officer of Health, East London.

(Abstracted from the *South African Journal of Science.*)

Gracvenbroeck (1685) and Kolben (1736), who is supposed to have copied most of his information from the first named, both give interesting accounts of the manners and methods of the Hottentot Medicine Man. There was evidently a classification, such as still exists in S.W. Africa and Namaqualand, of disease into minor and major troubles. Minor sicknesses were treated by the herbalists ; in the major diseases the first step was consultation with the witch doctor. Divination by examination of the entrails of a slaughtered animal was used. There were distinct differences in the treatment of women and men. Much of the treatment was mere trickery such as sucking with the mouth of pieces of bone out of the back, and other such methods in which sleight of hand was useful.

All of the old observers from Graevenbroeck to Campbell in 1815, corroborate the noise cure, that is, that after medicines had failed, the patient was shaken, reproached for his intention of leaving this world by fair speeches and foul, and was thumped to keep life in him while the many helpers shrieked and howled. If he died during treatment, the noise was redoubled. After recovery an andersmaken or transition rite was undergone by the fortunate patient.

After the advent of the white man, small

pox, measles and less cleanly illnesses swept the country like plagues. Previous to the new comers' appearance, the common diseases were sore breasts, ophthalmias and umbilical hernias, the last named due to the use of fat on the new born baby's umbilical cord, which retarded drying. Coughs appear to have been common, but there are no ancient Hottentot remedies for rheumatism, venereal disease, or tuberculosis; those for the last two diseases are of quite recent origin. Those used for phthisis are used on the score of analogy; the chief symptom is a cough, therefore, those remedies used for simple coughs are given. For the wasting of advanced tubercular disease there is to-day one outstanding item, Kattendoorn root, the roots of which spread out horizontally beneath the surface of the ground, as do the veins beneath the skin of a muscular man. Therefore, it must, by Hottentot argument, be a good " blood giver." This is an instance of the modern application of ancient sympathetic method.

The further information here gathered together, represents the work of four years' questioning, checking, and corroborating statements made by many herbalists, not a few of whom were also practitioners of witchcraft, that is, practitioners of major qualifications. One took four bottles of water mixed with earth and the ground remains of a certain little red-headed hornet that builds in houses and huts. Before rising each morning he drank a mouthful of the suspension. On the fifth day of this treatment; " there lay the sick people—and there lay the medicines. And now pressed the new power between the shoulders." Here, perhaps, is some small relic of the initiation of a man into the cult of P/gai* aup.

Only occasionally is there a little resemblance between the herbs used by the Native and those of the modern occidental pharmacopœia. Yet there is a sufficient similarity between them to cause the scoffer to cease his scoffing, and realise that here, after all, lies the root and origin of modern medicine —modern scientific medicine which owes at least one of ts drugs to this ancient Hottentot herbal, namely, Buchu. The bitter roots are similar in appearance on cross section, colour of infusion ,taste, and action to the Radi Calumbæ of modern pharmacy. But, with this one exception, there is no commercial future for any other item. The quantity of most of the herbs and medicinal bushes in the country is but small.

Red substances are used in anæmias and weaknesses, and repeated doses are given during fevers. They are used, several authorities state, because they are red and the blood is red, and therefore they strengthen the blood, and, of course, when grown on red ground, their value as drugs is increased enormously. All such red materials when used and finished with must be disposed of carefully, because good stuff must never be thrown away. Rooi wortle, for weaknesses, Baboon's ear, the Kalkoen bloom, Rooi rainkie, are examples, and in each the reason for use is their colour, and, should they grow in red ground, they must be good. The same principle is expressed in the use of the dark lichen which grows on almost all granite outcrops in Namaqualand, which is used in decoction as a mouth-wash for teething.

Barend makes young people's medicine as the moon grows during the first days of the month, and never prepares any when the moon is on the wane. Yet he examines cut sections of roots to see if they come from poor ground. He evidently works on a combination of "scientific" and "sympathetic" lines. The same medicine prepared in a different manner may have a different action. Thus, if black root be cut in an upward direction it will act as an emetic; should it be cut downwards it is transformed into a purgative. The Fleer-boom, also, is used in this manner. Purgatives have a strange fascination for the Native, and for pains in the stomach or " fevers " they have been used to " work them out," that is, a tangible removal must always, they argue, be productive of good, for they firmly believe that whatever they suffer is caused by a tangible something.

Rule of thumb methods prevailed in treatment, and the lore was handed down from father to son. In the beginning, man noticed that when he awakened in the morning he felt at his best, worked, or hunted better than later in the day; slackener and grew tired as the sun sank beneath the western horizon. Then he jumped to the conclusion that the rising of the sun was responsible for well-being, growth, and strength; and that the falling, setting sun was responsible for tiredness, failing strength and death. Therefore, the old tooth was thrown towards the rising sun, but a P/gai aup or witch doctor would

* For ease in printing and reading I have denoted the clicks thus :— D/ the dental; P/ the palatal; C/ the cerebral; L/ the lateral, and X/ the guttural.

throw it towards the setting sun to produce an evil effect. A fright was something tangible, and Nama women still by palpation diagnose the presence of a lump, a crystallised fright that has settled in the stomach. They state, too, that the woman's " life place " resides on the right side, and that when she is sickly it moves about.

From the details of this herbal lore it appears that the chief medical ailments treated by the Hottentots were pains in the stomach and fevers, classed together as " fires," and distinguished only by locality, flatulence as an entity, diarrhœa, and among the accidental injuries, burns. Several specific complaints had specific treatment. Kolben described the treatment of headache by shaving the head with a sharp knife, leaving furrows between the mounds of hair. If the cause was supposed to be a " wind in the head," then massage was applied to the nape of the neck; and snuff of " dooba," which smells of garlic (asafœtida) was used. A case occurred during 1923 in Namaqualand of scarification of the temples as treatment for madness. Old writers mention this as the means whereby pains were let out. Infantile convulsions must have given the old women much work. A favourite prescription for this complaint was, and still iss, Stink kruit leaves, the dried kidney of the D/aie jackall, and the sea bean, whatever that may be. Of these a powder is made which is worked into a linen band (in old days, a strip of hide) and fastened round the neck of the small patient. Small doses are then given internally mixed with mother's milk. The treatment is continued for one moon.

Alternating periods of famine and feast upset many stomachs. When excess was recognised to be the cause of his discomfort, the Hottentot took the juice of aloes in warm broth. The leaves to-day are dried and chopped up as required.

Massage.

Where pain was felt, fat was rubbed in. If this was unsuccessful, then the doctor performed passes over the part with his hands, and then let drop a piece of wood from the nose and asserted that it was out of the patient's flesh. (Campbell.) Plasters of fat were applied from a freshly killed animal, and motions made with the hands over the plaster, so that medicine was combined with magic. Should that fail, then incisions were made. Massage was, and still is, in common use, and is called P/gourie. When women are behind their time with menstruation a rolling movement of the hand on the stomach is the correct method of treatment, and presumably it was a loosening motion. For pains and sprains, punching, kneading, and rolling are employed. P/koo is the transference of heat from a fire to the part affected by the intermediation of the hand, which is warmed and applied gently. In the case of the unfruitful woman, she is massaged downwards on the abdomen. If this does not produce the desired effect, then the P/gai aup may be consulted, and he may do the rubbing.

Surgery.

The Hottentots' knowledge of surgery was limited. They successfully reduced dislocations. The joint was rubbed briskly with fat and the limb then moved briskly up and down. For example, a dislocation of the right shoulder would be reduced by gripping the patient's hand as though about to shake, and then vigorously pulling him towards and then pushing him away from one. Campbell says that they tied splinters of wood around broken limbs and left them until the bone was firm again.

Amputation of a finger joint was common and possibly led to experiments upon larger limbs. Kolben states that the head of the joint of the finger was tied up with sinew, and then cut through below. To the raw surface, leaves of myrrh and sweet herbs were applied and tied on. He suggests that this method was used for the removal of larger limbs, and a skeleton found near Garies showed that a limb might be removed or lost and the patient live for at least a while afterwards. Our old Nama woman stated that the " old people," when a leg was badly broken, amputated it through the knee joint after tying a thong tightly around the lower end of the thigh. It is common knowledge that the native is an expert in disjointing any animal. The operation of gelding animals, especially bull calves, was in daily use and was performed by bruising the testicles between two stones. The monorchism, so frequently referred to by early travellers when writing of the Hottentot, was doubtless the application of the same method to male babies with the intention of reducing the number of twins born —once again a sympathetic reason.

Kolben describes the operation of bleeding. First a thong was tied around the limb, and the vein opened below it. When enough blood had been drawn off, the incision was closed with mutton fat and the leaf of some herb placed over it. Alexander says that they were fond of bleeding, and the backs and sides of many were thickly

scored with the knife. They were not over-particular about having a horn for cupping, the mouth frequently being used for that purpose.

The Nama supping horn, as still in use, is a carefully prepared tip of ox horn open at both ends, with the broader end carefully bevelled from within outwards. The smaller end is closed with a ball of soft worked resin, which is pierced by a long thorn. The horn is applied to the scarified skin and the operator sucks hard. When suction is well established he bites the resin and so closes the aperture. The horn is left in place until the required amount of blood has been withdrawn. An exacty similar mode of using a similar instrument occurs in India.

Cupping is used for colics and pains in the stomach. The patient lies on his back and the horn is first applied dry, that is, over the unscarified surface of the skin, to produce insensibility. The numbed part is then scarified. If the pain moves to another area, the part is rubbed with hot fat and again cupped. If this fails, an infusion of herbs is given to drink. In the old days, cupping horns were carried to draw out the poison from arrow wounds, and also a little bottle or horn of oil with which to wash the injury, but scarification and suction applied by the mouth was also in favour. Scarification and cupping are also used for the relief of madness and epilepsy.

PREVENTIVE MEDICINE.

Preventive medicine was an important and extensive section of Hottentot medical lore and took the form of charms and incantations. When a rhild lost a milk tooth, he took the tooth, and standing facing the rising sun repeated the two lines :—

" P/gko c/gkohp Ba-ooe D/koee
D/ghumba ma dae,"

which may be translated, " Dassie, take my bone tooth and send me a stone tooth." The Dassie is the rock rabbit, so here there appears to be a double magical significance.

The remainder of the subject of charms, including those magic necklets to prevent attack by wild beasts or to prevent effect of witchcraft, can be considered correctly only in a separate article. But it is necessary to remember that there was no activity of Hottentot life which was not affected by signs, portents, charms or ritual, which he employed to foretell or warn of coming ill-luck, and which enabled him to prevent or remove the ill effects of them and of any other bad influence, whether induced by act of God or practice of witchcraft.

(To be continued.)

CONSUMER CREDIT.

By J. GIBSON JARVIE, Barrister-at-Law.
(Managing Director, United Dominions Trust, Ltd.)

Summary of a Lecture delivered before the Incorporated Accountants' Students Society, on Tuesday, 19 March, 1929.

Mr. Gibson Jarvie said :—

Modern problems could not be solved by the methods of yesterday, and many of our accepted economic doctrines requires to be overhauled. Too often the theoretical economist was merely an historian masquerading as a pioneer.

While credit was accepted as an essential part of the industrial and financial machine, it had not yet been accorded its rightful place, with the result that a great deal of credit was allowed to run to waste. Hoarded gold and unused credit were the buried talents of commerce. To-day, the whole subject of credit required to be re-examined with an open, if critical mind, and perhaps with the warning that theory had become a cloud which threatened to shut out the light of practical experience.

Production credit had long been accepted as necessary and respectable, but the value of its counterpart—consumer credit—was only now being appreciated. We had blundered into the attitude of accepting credit as the masters of trade, whereas trade, or the satisfaction of the legitimate wants of the world, should control credit and money. Money had been given a false value, and placed on a throne to which it was merely a pretender.

By the use of production credit, in the absence of an effective system of distribution, goods were too often left to depreciate in warehouses, with a resultant loss of turnover and employment and the creation of the bankers bugbear of " frozen credits," and all that these meant in the restriction of trade. We had to go further, therefore, and organise distribution through the application of consumer credit.

Consumer credit had come to the fore in the form of instalment selling or hire purchase, and it had demanded recognition mainly because in the United States it had reached proportions which refused to be ignored. Hire purchase had helped America to a staggering increase in national and international trade, and the production of vast quantities of material wealth had there resulted in high wages, increased savings, increased life insurance, and an almost incredible state of general prosperity. So consumer credit was now recognised as an

indispensable part of American economic life.

Consumer credit had been applied, in the main, to articles of utility with lasting value, and to articles of a productive nature, and throughout its period of growth the credit structure of the United States had maintained a definite relationship with the increase in material wealth and production. Again, the aggregate amount of instalment credits outstanding in the United States was only a small proportion of the total credit. These were important points that were apt to be overlooked. Consumer credit, it had also to be pointed out, did not cause inflation, because the new production of commodities kept pace with the credit created.

Consumer credit could accomplish in England what it had accomplished in the United States. It could produce moregoods; distribute these goods; lower costs; encourage the production of more goods than could be consumed at home and so enable us to re-enter foreign markets on a lower price level, and recapture our export trade.

It had been said that consumer credit or instalment selling was merely " mortgaging future income." This meant, if it meant anything at all, that there would ensue a hiatus in next year's trade and that a year would come in which there would be no trade, a contingency which might indeed spell disaster.

There was no truth in this suggestion. " Mortgaging future income " meant that the mortgagors had capitalised their credit, and by so doing had secured and enjoyed to-day something which otherwise they would not secure till some later date. They had, in fact, called into being new material wealth in the shape of goods, the production of which had meant wages paid, factories employed, increased profits, and the possibility of further savings. They had accelerated production, which meant bigger production and lower prices, which, in turn, provided more competitive terms and wider markets. The resultant increase in the current national income might, in fact, offset the so-called anticipation of next year's demand. By the use of consumer credit, the national income was automatically increased this year. It could not, in face of the new stimulus, remain at the original figure. Thus the so-called " mortgaging of future income " did, in fact, expand trade, create employment, and make the nation more prosperous.

Thouse who sought arbitrarily to limit the use of this most effective weapon—consumer credit—were denying to the smaller people their true and just demands for greater material and cultural wealth, and were, at the same time, enjoining on their fellows a social monasticism and asceticism as distasteful as it was unnecessary and harmful. They were forcing on the people the principle, " Do without," and the philosophy of " taboo," instead of the newer, richer, and greater philosophy, " produce, secure, and enjoy."

Many people associated consumer credit with two evils—the encouragement of the purchase of luxuries and an unsound element of risk. In practice, consumer credit had been provided not for the purchase of luxuries but, in the main, for the satisfaction of legitimate demands, and also for the purchase of up-to-date plant and equipment, modernised transport, and generally for goods of lasting or productive value. As for the element of risk, consumer credit was not granted indiscriminately, and in the general experience of financial houses the business was essentially sound. In the case of the United Dominions Trust, for example, the losses for the past three years, on many millions of business, had been approximately one-twentieth of one per cent.

In general, the possibilities of consumer credit were so enormous that in future it would probably claim a large part of the work now done by capital. As a matter of fact, it had already taken over many of the functions of capital, and rightly so.

Capital as a factor in production had its limitations and its disadvantages. It might be provided for a specific purpose on which a reasonable return was to be expected, but when lean times came it still demanded dividends or failing these, it brought a loss of prestige. On the other hand, when new plant was required for a specific purpose, it would probably pay its way for some time at any rate—otherwise it would not be held to be necessary—and then when its cost had been met by instalment payments, it remained an unburdened asset of the business, carrying no claim for an annual dividend. For this reason, consumer credit would tend to absorb some of the present functions of capital.

A final advantage of consumer credit was that it could be granted to the merchant practically on a cash basis. The merchant would receive a deposit, ranging from ten to thirty per cent., and then, having procured the appropriate documents from the instalment buyer, would encash these at a

commercial banking house, such as the United Dominions Trust, and receive the balance of the selling price. Thus the merchant, while disposing of his goods on a credit basis, would, at the same time receive their full cash value, and thus be free to use the money again in his own business of producing and selling goods.

CHEMICAL INDUSTRIES.

The Belgian chemical industry continues the marked extension and improvement which have characterised the post-war development of this branch. Amalgamations, increased capital and the installation of new plant have been a feature of 1928 and several new factories have been set up for various chemical processes, amongst others one for the treatment o fcasein and certain colours, chiefly white, used in the manufacture of playing cards in the Turnhout district, and one for refining petroleum. Several others have been erected for the manufacture of synthetic ammonia. The development of this latter industry has been particularly remarkable, and the output of this product by the Claude process is said to have increased tenfold since 1925. The total output is now estimated at 85,000 tons of synthetic ammonium sulphate per annum. The manufacture of synthetic ammonia has been greatly helped by the improved use of the recovered gases from coke-ovens which ensures a sufficient supply of hydrogen at a cheap rate. The utilisation of coke oven gases has also made great progress in regard to the production of many other chemicals.

The Union Chimique Belge, formed in January, 1928, with a capital of Frs. 715 million, groups a number of factories representing one-third of the output of acids.

Owing to the nature of the soil and its intensive cultivation, chemical manures are extensively used in Belgium. According to a recent estimate the total consumption of fertilisers increased 79 per cent. between the years 1913 and 1925. The demand for *superphosphates* is supplied largely from home production, but the supply of *nitrogenous fertilisers*, about 44,000 tons of which are consumed annually, is insufficient. The national output, which in 1925 amounted to only 14,000 tons, is being increased, as is also the output of *ammonium sulphate*, for which several new factories have been opened in recent years.

The use of *cyanamide* also shows a steady increase, having risen from 5,000 tons in 1919/20 to 31,500 tons in 1926-27.

One chemical factory is now making a new fertiliser containing nitrogen, phosphoric acid and potassium. The annual output of this factory, working with one shift, will, it is estimated, amount to 20,000 tons. It is proposed to work also for the export market.

As already stated, the chemical industry during 1928 continued the process of amalgamation and the important banks have supported finan ially the closer co-operation which is being arranged between this industry and the coal and non-ferrous metal industries. A new electro-chemical company has been formed with a capital of Frs. 21 million, while two new companies we e constituted under the auspices of a bank for the treatment of by-products from coal-distillation.

New works have been erected for the production of carbonalpha, while an important firm proposes to obtain from the Congo Colony the supplies of ammonium sulphate required for its electrolytic copper works, and has formed a chemical company in the Katanga for this purpose. The demand for basic slag was good and prices firm.

GENERAL NOTES.

EDINBURGH PROPOSALS FOR LOCAL PRODUCTION OF SMOKELESS FUEL.

The Edinburgh Town Council will consider at the forthcoming meeting the possibilities of extending, by local production, the supplies and use of smokeless fuel.

This step is a sequel to the recommendation of the recent National Smoke Abatement Conference that municipalities should investigate the question for themselves.

The gas committee will be asked to report on two aspects of the subject, namely :

(*a*) The general question of smokeless fuel production, with any practical proposals for forwarding its manufacture locally.

(*b*) The manufacture and sale "on an adequate commercial basis" of smokeless fuel produced by the low temperature carbonisation of coal.

Glasgow has already its own municipal smokeless fuel supply, and is the first municipality to establish a low temperature carbonisation plant.

NEW USE FOR WASTE STRAW.

A company has been incorporated at Regina, Saskatchewan, for the manufacture from waste straw of a board intended for use in the place of timber in the construction of buildings. One machine has recently been placed in operation on the farm of Mr. T. A. McCusker, one mile north of Regina. The patented product is called " Solomite," and Dr. E. A. McCusker, of Regina, is organising the Solomite Company of Canada to manufacture the new building material. Patent rights for Canada have been acquired. It is stated that the machine compresses straw under a pressure of 100 pounds to the square inch, the product being laced with wire and turned out in boards 14 feet long by 5 feet wide and 2 inches thick. The machine turns out 4,000 square feet of straw board per day. It is contended that the product is fireproof on account of the pressure to which it is subjected and that it possesses insulating qualities to a high degree.

BLEACHING OF RAYON.

Rayon is often placed on the market in an unbleached condition and the dyer is concerned with bleaching it either in hank or piece form (says *Rayon Record*). This of course is only necessary when the final product is to be pure white or dyed a pale shade. If it is to be bleached in combination with other textile fibres no hank bleaching will be performed, but the fabric will be piece bleached, thus minimising any tendency for tendering which might occur with two bleachings. When only vegetable fibres are used along with artificial silk the most convenient bleach is calcium hypochlorite or, preferably, sodium hypochlorite of not greater than 1.4° Tw. In this connection, mention must be made of Bemberg silk, cuprammonium silk spun by the stretch-spinning process and giving filaments closely resembling those of pure silk. This silk is peculiarly liable to disastrous effects from any slight overbleaching and great care has to be taken to avoid this. To obtain an even effect the silk must be well wetted out with a 5 per cent. solution of sodium carbonate. The necessity for this treatment is obviated by the addition of " Floranite " to the chlorine liquor, resulting in complete removal of paraffin from the goods and ensuring level dyeing as well as stabilising the liquor. The amount added is 1 gram per litre of liquor and the goods can be transferred to a souring bath without rinsing. By this method an excellent white not subject to yellowing is obtained.

COMMONWEALTH OF AUSTRALIA.—COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

SECOND ANNUAL REPORT, FOR PERIOD ENDED 30 JUNE, 1928.

(*Continued from page 396.*)

In addition to the organisations in Great Britain mentioned above, close relations have been established with bodies corresponding to the Council in the other parts of the Empire. In Canada the counterpart of the Council is the Advisory Council of Science and Industry. It has recently been decided by the Government concerned to enlarge the activities of this body very considerably and it is understood that a Bill to give effect to that decision is to be introduced at an early late. The Canadian body is already engaged in many investigations of interest to Australia, notably in connection with forest products and with problems connected with the production of cereals. It also proposes to establish the nucleus of a National Physical Laboratory or Bureau of Standards.

Coming nearer home, the New Zealand Department of Scientific and Industrial Research and the Council are collaborating and helping each other in a number of matters. Naturally, many problems are of mutual interest and concern.

In the case of India, too, there is mutual interest in forests products. The work of the long-established Forests Products Research Institute at Dehra Dun will soon have its counterpart in the forests products organisation of the Council and the authorities of the two bodies have already established touch.

To sum up, the Council is fully alive to the desirability of its forming one of a team in an Empire-wide attack on the various problems that now confront the Empire as a whole. The free interchange of information that is already taking place between the component organisations of that team will ensure the minimum of overlapping and will lead to the most efficient and effective work. Incidentally, it will result in considerable savings to Australia. The Council hopes that, in return, it will be able to play its part and furnish results of equal value to the other parts of the Empire.

A similar movement for the establishment of team work in matters of scientific research is becoming somewhat evident throughout the world as a whole. Various organisations in the United States of America, for instance, have taken up an extremely helpful attitude. Scientific organi-

sations in other countries, too, have adopted a similar attitude to those mentioned in the United States. Up to date, the lines of co-operation that have been established have been mainly in the direction of an interchange of co-operation that have been established have been mainly in the direction of an interchange of published and unpublished reports. In this way the Council is gradually becoming a central repository of much scientific literature of value in connection with the study of our national problems.

TRADE IN BRITISH MALAYA, 1928.

The Department of Overseas Trade has issued, through H.M. Stationery Office, a review of the Trade of British Malaya in 1928, by Mr. L. B. Beale, C.B.E. (H.M. Trade Commissioner). On account of its situation and its position in world trade as a producer of rubber and tin, British Malaya has acquired considerable importance in the East. Its area is roughly the same as England's, but the population is only 4 millions, and much of the trade is in Chinese hands. The present producton of rubber, tin, Copra, palm oil and other natural products represents only a small fraction of the country's capacity. There is a market for manufactured goods which has hitherto not received as much attention as the results would justify. Mr. Beale summarises the trade prospects and gives detailed statistics in relation to the trade.

The report is obtainable at the price of 3s. 2d., post free, from His Majesty's Stationery Office, at Adastral House, Kingsway, London, W.C.2.; York Street, Manchester; 1, St. George's Crescent, Cardiff; or 120, George Street, Edinburgh.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

The David Ferrier Lecture was read on Thursday, June 20 :—

Some Functional Problems Attaching to Convergence. By SIR CHARLES SHERRINGTON, O.M., F.R.S.

The arrangement of the conducting paths of the nervous system, branching and redistributing their impulses as they do, exhibits places where numerous convergent paths run into one. When at such places two or more of the converging arcs are concurrently active, the trains of impulses arriving by them can interact. Such convergent places are co-ordination points. An example of much importance, and relatively accessible to experiment, is that in the spinal cord, where the motor nerve-cells innervating a muscle receive as a group the various afferent paths which reflexly operate the muscle. If two or more of the convergent afferent nerves are excited concurrently the reflex interaction, as revealed by the muscle, exhibits three main sets of cases.

In one set of cases the muscular response under concurrent stimulation of two or more afferents shows a deficit in amount as compared with the sum of the responses obtainable from the several afferents taken separately. This occurs especially when the excitation of the reflexes is strong; it is most marked when they are of maximal strength. The contraction effect of one afferent may default altogether. The result might seem to indicate inhibition, but analysis shows that it is not referable to any form of inhibition. The explanation lies in the limitations of the contraction response of the muscle fibres of the motor-units activated; the contraction effect pertaining to one afferent being "occluded" for the time being by that pertaining to another. "Occlusion" is a result of the overlap of different afferent arcs upon the same motor-units; this overlap is "central," *e.g.*, in the spinal cord. The amount of "occlusion" as observed by the myograph gives a measure of the amount of that "central" overlap. In such estimates, however, the assumption is made that the component motor-units of the muscle all of them possess individually the average value of contraction-tension which obtains for them. Thus in the knee-flexor (cat) semitendinosus has a value which is only one-third of that obtaining for gastrocnemius. It is, however, certain that the individual motor-units differ considerably in contraction-value within one and the same muscle. Examined by occlusion the overlap of the constituent branches of a single large afferent nerve upon its motor-units can be well above tenfold. This gives a functional picture in harmony with the histological picture furnished long since by Cajal.

In another set of cases on the contrary, the contraction response of the muscle, under concurrent stimulation of two or more reflex arcs which are excitatory for it, shows a surplus of contraction as compared with the sum of the responses to the component afferents taken separately. This result is most evident with weak reflexes. As with the other set of cases this result also, al-

though opposite to the previous class, brings evidence of the overlap of the convergent arcs upon the central ends of motor-units held by them in common. Moreover, evidence is thus furnished that central states of excitement, individually too weak to provoke the motor-units into discharging activity, can by summation become effective for that activation. The reflex excitation provoking contraction of the muscle is shown to be accompanied regularly in the spinal centre by concomitant subliminal excitation in other spinal motor cells over and above those excited to actual discharge. The time relation of central subliminal excited states obtaining in certain typical reflexes has been determined (J. C. Eccles). By the summation of subliminal excited states this fringe of subliminal effect is a functional means of liaison enabling co-operation between different adjuvant parts of the nervous system.

Although the neuron upon which convergent arcs interact is subject to their combined influence, and is to that extent an instrument passive in their hands, it is an instrument clearly with ways of its own. Thus, to receipt of a single stimulus it may react by a response consisting of a whole tetanic series of impulses.

Another and third set of cases arising from interaction at the convergence point is where the upshot is inhibition. The clash is between "central" excitation and a central process which arrests or precludes it, but about which all that is known is that it antagonises excitation. Evidence is adduced of the quantitative interplay of the opposed influences upon the individual neuron. Conditions favouring inhibition are discussed.

Though trains of impulses are the sole reactions which enter and leave the central nervous system, it is clear that nervous impulses are not the sole reactions functioning within that system. States of excitement which can sum together, and states of inhibition which can sum together, and states which represent the algebraical summation of these two, are among the central reactions. The specific cell units, the neurons, far from behaving merely as passive recipients and transmitters of impulses, modify as well as transmit what they receive.

MINERALOGICAL SOCIETY.

Papers read on Tuesday, June 11, Dr. G. T. Prior, President, in the chair :—

Bismutotantalite, a New Mineral from Uganda. By E. J. WAYLAND AND DR. L. J. SPENCER.

This was found in a pegmatite vein at Gamba Hill, about 35 miles N.W. of Entebbe. The large rough crystals, weighing up to a kilogram or more, are orthorhombic with a habit and axial ratios similar to those of columbite. Analyses made by W. O. R. Wynn at the Imperial Institute give the formula $Bi_2O_3.Ta_2O_5$, analogous to stibiotantalite ($Sb_2O_3.Ta_2O_5$).

On a Partially-Fused Quartz-Felspar Rock and on Glomero-Granular Texture. By DR. L. HAWKES.

In a partially melted granite fusion began at the quartz-felspar contacts. It is suggested that the temperature was raised above the eutectic point but not to the melting point of any of the constituent minerals, and that a granite of quartz-orthoclase-albite eutectic composition will melt completely in the dry state below 950° C. Coarse grained granites may exhibit a segregation of quartz and felspar, revealed in section by monomineralic areas of several grains in anhedral intergrowth. The name "glomero-granular" is proposed for this texture which may result from the normal undisturbed crystallisation of the magma.

The Occurrence of a Mineral Hitherto Unrecognised in the Phonolites of Dunedin, New Zealand. By DR. P. MARSHALL.

A mineral with low birefringence and low refractive index, hitherto taken to be either nepheline or sodalite is shown to be distinct from these and to be nearer microsommite or davyne. It is usually allotriomorphic but also occurs as very small (0.15 mm.) hexagonal prisms. Analyses of HCl-solution of phonolites containing this mineral to the exclusion of other soluble silicates, indicate that it is a sodium alumino-silicate loosely combined with sodium chloride. The mineral stains dark violet when treated with silver nitrate. The name proposed for the mineral is ameletite.

The Meteoric Stone of Lake Brown, Western Australia. By DR. G. T. PRIOR.

The stone, weighing when found 4.75 kg., has been known since 1919. Chemical analysis and microscopic examination prove it to be an intermediate hypersthene-chondrite of Baroti type.

Fülöppite, a New Hungarian Mineral of the Plagionite-Semseyite Group. By I. DE FINALY AND DR. SANDOR KOCH.

This was found at Nagybánya, Hungary [=Baia Mare, Rumania] as small monoclinic crystals of the plagionite habit. Analysis shows it to be an acid member of the

group with the formula $2PbS.3Sb_2S_3$. Associated with it is an acicular (probably orthorhombic) lead-antimony mineral with the composition $3PbS.4Sb_2S_3$, which is compared with the Bolivian keeleyite.

ROYAL SOCIETY OF ARTS.

SIXTH ANNUAL COMPETITION OF INDUSTRIAL DESIGNS.

The entries for this year's Competition have now been received and although, until they have all been checked and classified, it is not yet possible to state the exact number of designs entered, it is quite evident the interest in the Competition is well maintained and that there will be a further increase this year in the number of competitors and designs. Last year there were 1024 competitors and 3126 mounts of designs. So far as can be ascertained at present the numbers this year will be 1,240 competitors and about 3,500 designs. There is a large number of entries for Textile designs which show an increase of about 300 on last year's figures — 959. As the number of Textile designs entered in 1927 was 487 the increase in the last two years is noteworthy. In the Advertising Section there is an increase of over 300 designs so that this year's entries for Posters, Show-cards, etc., are 600 in excess o fthose of 1927. There is an innovation this year in the Pottery and Glass Section as 140 actual specimens of fired pottery have been entered. The number of entries for the various other Sections of the Competition are about the same as in previous years.

The judging of the designs and awarding of the various Scholarships and Prizes will take place in July, and the accepted designs will be on view at the Imperial Institute, South Kensington, S.W., from August 3 to September 1, Sundays included.

It is interesting to note that offers of Prizes for designs in connection with the Competitions for 1930 have already been received from several other important manufacturers.

THE CHEMICAL SOCIETY.

Papers read on Thursday, June 20 :—

Manipulation in Intensive Drying. By H. B. BARKER.

Details of the methods used in preparing apparatus for use in experiments on intensive drying are given in detail. The choice of glass and silica, their preliminary treatment and the care used in the making of the apparatus, are shown to be of great importance, it is especially necessary to guard against water which is adsorbed by the glass and may be liberated in the course of the experiment. Reasons are given for heating the apparatus in a current of air, rather than heating *in vacuo* during the preliminary drying. Purification of materials considerably beyond that used for atomic weight determination is found to be necessary.

Notes on Intensive Drying of Gaseous Media. By W. A. BONE.

The author endorses generally the procedure and precautions laid down by Prof. H. B. Baker for the intensive drying of gaseous media, and adds thereto a few further special precautions which he has observed during his own recent experiments on the intensive drying of carbon-monoxide-oxygen mixtures.

The Light Emission from the Phosphorescent Flames of Ether, Acetaldehyde, Propaldehyde, and n-Hexane. By H. G. EMELEUS.

The phosphorescent flames of acetaldehyde, propaldehyde, and *n*-hexane, obtained by passing the vapour-air mixture through a heated tube just below the ignition point, gave the same spectrum as was previously observed in the oxidation of ether under similar conditions (J., 1926, 2948). This differed completely from the normal flame spectrum. Vacuum fractionation of the oxidation product for acetaldehyde showed the presence of unchanged acetaldehyde. From the reaction product of the ether flame acetaldehyde was also isolated, but not in the case of the oxidation of propaldehyde and *n*-hexane. This evidence is against the view that the light emission is due in each case to the oxidation of acetaldehyde formed as an ntermediate.

The Relative Configurations of d-β-Octanoland its Dextro-rotatory Halides. The Interconversion of the Optically Active -Octanols by a New Method. By A. J. H. HOUSSA, J. KENYON AND H. PHILLIPS.

The *p*-toluenesulphonyl derivative of *d*-β-octanol reacts in ethyl alcoholic solution with (*a*) potassium acetate (*b*) lithium chloride to give β-octyl acetate and β-chlorooctane respectively. Both these products are lævorotatory.

Reaction (2*a*) provides a new method by which optically active alcohols can be interconverted. Evidence is forthcoming that during reactions (1*a*) and (2*a*) Walden inversions occur, and since reactions (1*b*) and

(2*b*) are reactions of the same type, it is concluded that they are also accompanied by Walden inversions. The configuration of *d*-β-octanol is therefore the same as that of its dextrorotatory halides.

Analyses of the Cereal Grains—Oats. By J. L. Baker and H. F. E. Hulton.

The amylases obtainable from rye and barley before germination are unable to carry the hydrolysis of starch as far as can the amylase present in the same materials after germination (that is, when malted); with oat diastase this *rôle* is reversed, since a 97 per cent. yield of maltose is obtainable by the action of ungerminated oat diastase on soluble starch and a smaller yield when using the amylase of malted oats. The general conclusions are :—The amylase precipitated by alcohol from ungerminated oats when allowed to act in sufficient amount on soluble potato starch at 50° yields only crystalline maltose, differing in this respect from the amylases of other ungerminated cereals which have hitherto been examined. If the conversion be stopped before completion a substance practically identical with α-amylodextrin previously described by one of the authors and crystalline maltose are formed. The amylase liquefies starch paste slowly and less easily than the amylase of ungerminated rye. Ungerminated oat amylase has a solvent action on oat starch granules producing dextrin.

The results support the hypothesis that starch consists of condensed maltose residues, and appear irreconcilable with the theory put forward by Maquenne and Roux and elaborated by Ling and Nanji, that the starch molecule is composed of amylase and amylopectin.

SOCIETY OF GLASS TECHNOLOGY.

A joint meeting with the Physical Society was held at the Research Laboratories of the General Electric Co., Ltd., on Tuesday, May 14, Dr. W. H. Eccles, President of the Physical Society, in the chair. The following three papers were communicated :—

A Study of the Thermal Expansion of Glass up to the Softening Temperature. By Prof. W. E. S. Turner and F. Winks, M.Sc.Tech.

A comprehensive survey was made of the linear expansion of different types of glass from room temperature up to the softening point. It was shown that careful attention must be paid to the physical condition of the sample of glass under test if comparable results are to be obtained.

A wide range of glasses was examined, including the following series, each series of which was comprised of several different glasses with the following components :—

Soda-silica, soda-lime-silica, soda-lime-silica coloured with cobalt oxide, soda-barium oxide-silica, soda-lead oxide silica, soda-iron oxide-silica, potash-lead oxide-silica, and a number of glasses of more complex character.

The curves obtained by plotting the increase in length per unit length against temperature showed two very marked changes in direction on two points described as the lower critical and the upper critical point, the temperatures corresponding to these marking the limit of the so-called annealing range. The extent of this range and the slope of the curve varied considerably with the composition.

It was shown that over the temperature range between room temperature and the lower critical point the curve indicating the relationship between increase in length and temperature was, in most cases, not a straight line, but was made up of two, three, or more sections, each of which was precisely linear. The points of inflexion of the surves in this lower temperature range were closely the same for all glasses built up according to a common general formula. The first inflexion point occurred between 120 and 150, the second at about 250, and where a third break occurred, at about 350. These breaks did not occur in the potash-lead oxide-silica glass examined, and were scarcely existent in the soda-lime-silica glasses containing small amounts of cobalt oxide.

Glasses containing boric oxide as a constituent were particularly difficult subjects of test, and showed themselves very sensitive to heat treatment.

When the linear expansions of the glasses were plotted against the percentage values of the dintinguishing oxide present in the glasses for the temperature ranges 0-120° or 150°; 150-250° and 250°-the lower critical temperature, it was found that the points lay on a series of straight lines. The relationship between the expansion and percentage of oxide was, therefore, linear over these temperature ntervals. Factors were obtained from these graphs for each oxide, and by their use it was possible to calculate the linear expansions of glasses up to the critical temperature.

The Measurement of the Viscosity of Glass at High Temperatures by the Rotating Cylinder Viscometer. By R. F. Proctor, B.Sc., A.M.I.E.E., and R. W. Douglas.

(A communication from the Staff of the Research Laboratories of the General Electric Co., Ltd., Wembley.)

The viscosity of glass was measured by the authors using the rotating cylinder method. A full description of the apparatus used was given. Calibration at low viscosities had been achieved by the use of golden syrup, while pitch was employed in the use of high viscosity.

Contrary to E. W. Washburn's experience, the calibration factor for a rotating cylinder viscometer was independent of the viscosity, at least over the range 10^3-10^8 c.g.s. units. From results of experiments made with sodium silicates, the authors concluded that the variation found by Washburn in his calibration factor, was due to the formation of a skin on the surface of the liquids used.

Using a glass of composition similar to those used by the earlier workers, S. English, V. H. Stott, and E. W. Washburn, determinations were made on the viscosity over a considerable range of temperatures. The authors noted a reduction in the accuracy of their results round about 950-1,000° C., similar to that experienced previously by Stott.

In conclusion, it was shown that all the published data (including Washburn's work corrected by the authors) were in reasonable agreement when allowance was made for variations in the compositions of the glasses used.

The Photo-Elastic Properties of Glass. By F. C. Harris, M.Sc. (A communication from the Applied Mathematics Department, University College, London).

Mr. Harris briefly reviewed the stress-optical properties of glass, dealing with the effect on the stress-optical coefficient of chemical composition, and temperature.

The effect of composition had been investigated by F. Pockels in 1902, using a series of lead oxide containing glasses. The value of the stress-optical coefficient was found to decrease as the PbO percentage content increased, becoming zero for a glass containing about 75 per cent. PbO, and becoming negative for 80 per cent. PbO. These results were confirmed by L. N. G. Filon, who worked with PbO values beyond 80 per cent. Further, the coefficient was found to be increased by the addition of boric oxide, and decreased by potassium oxide, but the effect of these oxides was small compared with that of lead oxide.

Both Pockels and Filon had investigated the dispersion of double refraction in glasses, and glasses appeared to fall into two series. The effect of age and previous history of the glass might account for the difference in behaviour. The stress-optical coefficient of some glasses had been found to show an increase after a lapse of twenty years.

Rise in temperature increased the coefficient in most cases, an exception being a decrease exhibited by a heavy flint glass. Observations made on flint glass heated to 400°, with pressure then applied and maintained during cooling down to atmospheric temperature showed unbalanced stresses were exhibited by the cool glass, which, therefore, could not be regarded as a homogeneous substance.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

On the Reaction of Hydrogen Peroxide with Some Metallic Ions (3rd Report). *The Effect of Stabilizer, Concentrations and Various Metallic Acids on the Potential and Photographic Action of Hydrogen Peroxide.* By Shin-ichiro Hakomori.

On the Reaction of Hydrogen Peroxide with Some Metallic Ions. (4th Report). *Peracids and the Theory of Acid-Nucleus.* By Shin-ichiro Hakomori.

Iridium. II. Hydrolysis of Hexachloro-iridate M_2IrCl_6 *and Hexachloro-iridite* M_3IrCl_6. By Eijiro Ogawa.

Iridium III. Reaction Between Sodium Hexachloro-iridate and Sodium Oxalate. By Eijiro Ogawa.

Photochemical Change of Certain Substances. By Yushichi Nishizawa.

Hypoglycemia Producinge Substances. I. Synthesis of Certain Guanidine Derivatives. By Taizo Kumagai, Sin-iti Kawai, Yoshio Shikinami and Tatsuo Hosono.

TECHNOLOGY RESEARCH SCHOLARSHIPS.

A limited number of Research Scholarships in Technology (each of a value not exceeding £100) tenable during the academic year 1929-30 in the Manchester Municipal College of Technology (Faculty of Technology in the University of Manchester), will be awarded in July, 1929.

Applications must be received on or before 6 July, 1929. Forms of Application and all information may be obtained by written application to the Registrar of the College.

THE OPTICAL SOCIETY.

June 18.

The Beam Given by Dioptric Apparatus. By W. M. Hampton, Ph.D., B.Sc., F.Inst.P., A.I.C.

It is shown that the light in the axial direction given by a dioptric lens using a white source can only be white if the light source is above a certain limiting size. For such light sources a simple expression is deduced for the axial beam candle-power for light sources of smaller size than the critical value. This makes allowance for the variation of luminosity with wave-length for the source used. The distribution of light for directions not on the optical axis is also computed in a general way. The effect of the dispersion of the glass of the lens on the maximum distance at which satisfactory candle-power readings can be made is also considered. The case of fixed lenses is then studied and the general solution obtained for the intensity at any distance and in any direction for light of any colour. From this the candle-power on the horizontal plane is derived as a special case. The rest of the paper consists of numerical results for lenses of the Fresnel section in both revolving and fixed types. Tables to enable the calculation of candle-power to be made are included.

Dr. Moore, Mr. J. B. Bowen, Mr. J. R. Wharton and Mr. T. Smith took part in the discussion.

New Theodolites were exhibited by Messrs. Cooke, Troughton and Simms, Ltd., and by Messrs. E. R. Watts and Son, Ltd.

Experiments, Demonstrations, and Exhibits were arranged by the Technical Optics Department of the Imperial College, by the kind permission of the Director, Prof. A. O. Rankine, O.B.E., D.Sc. These included—

Equipment for ultra-violet microscopy.

Ultra-violet transmission of Corex glass.

Method of measuring the resolving power of microscopic objectives.

Examination of an ultra-violet emission spectrum by means of a Beck fluorescent spectroscope.

Stable immersion fluid for ultra-violet microscopy.

Apparatus for measuring refractive indices of liquids in the ultra-violet.

Examination of ultra-vioet transmitting media on the interferometer.

Exhibit of ultra-violet photo-micrographs.

Measurement of ultra-violet refractive indices on the spectrometer.

Forthcoming Events.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Monday, July 1, at 5 p.m.—General Meeting.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

17,165.—Bataafsche Petroleum Maatschappij — Process for absorbing ethylene, etc. June 4.

17,166.—Bataafsche Petroleum Maatschappij.—Process for absorbing olefines, etc. June 4.

17,167.—Bataafsche Petroleum Maatschappij.—Manufacture of alcohols. June 4.

17,509.—Bataafsche Petroleum Maatschappij.—Converting hydrocarbons. June 7.

17,099, 17,101.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of derivatives of naphthalene. June 4.

Specifications Published.

312,726.—Horsley, G. F., and Imperial Chemical Industries, Ltd.—Production of aluminium sulphate.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uuiform price of 1s. each.

Abstract Published.

309,834.—Titanium sulphate.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Sulphuric acid solutions of titanium sulphate are purified from particles of unchanged ore, carbon, and gangue by filtration through a filter cloth of nitrated cellulose. The solution must be free from trivalent titanium compounds, as the latter attack the filter cloth, but ferric iron in the solution may first be reduced, as by means of iron. A trivalent titanium compound may be added to the filtered solution, or be produced by further reduction, say electrolytic reduction.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

KLIK.

502,126.—Chemical substances used in photography and photographic films (sensitized).—F. W. Hampshire & Co. (1927), Limited, Sunnydale Works, Sinfin Lane, Derby. June 12.

CEMENTILK.

501,516.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—Pinchin, Johnson and Co., Ltd., General Buildings, Aldwych, London, W.C.2. June 12.

MIRELLA.

501,184.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—Alfred Ernest Goodman, trading as A. E. Goodman, 14, Chapel Street, Milton Street, London, E.C.2. June 12.

ETICIN.

502,388.—Chemical substances prepared for use in medicine and pharmacy.—Cavendish Chemical Company (New York) Limited, 187, Regent Street, London, W.1. June 12.

BACK NUMBERS WANTED.

Wanted, Numbers 8045, 8052, 8055, 8062. Double price paid.—Address, " Sciences," c/o *Chemical News* Manager.

" CHEMICAL NEWS "—

BACK NUMBERS WANTED,

BOUND OR UNBOUND.

Vol. 116—July to December.
Vol. 117—All 1918, 32 numbers.
Vol. 118—January to June, 1919.
Good Price given.

Address—
MANAGER, " CHEMICAL NEWS,"
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

THE CHEMICAL NEWS
AND JOURNAL OF INDUSTRIAL SCIENCE.
Founded in 1859 by Sir William Crookes, O.M.

Published every Thursday.

Can be ordered through any Newsagent or Bookstall, price 6d. per copy. Can be had direct, post free, for a year, for 30s.

Offices : MERTON HOUSE, SALISBURY SQ., LONDON, E.C.4.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from THE MANAGER,
THE CHEMICAL NEWS,
Offices : MERTON HOUSE, SALISBURY SQUARE.
LONDON, E.C.4.

URGENTLY WANTED

TO PURCHASE.

CHEMICAL NEWS:

No. 3061. Vol. 117.

also

No. 3400 Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

INDEX.

ABANDONED mines in Canada, Catalogue of, 269.
Absolute zero of temperature, 18.
Absolute zero of temperature, 81.
Absorption of penetrating radiation, 88.
Absorption spectrum of vitamin D, 300.
Acetic acid (New Patent), 175.
Action of air-carbon tetrachloride vapour mixtures on certain natural and artificial sulphides, selenides and telluride, 147.
Action of air carbon tetrachloride vapour mixtures on several natural sulphides, sulpharsenites and sulphantimonites, 385.
Addition compounds of hydrogen chloride with ether and acetone, 214.
Age of chemistry coming, 152.
Alcoholic beverages, The American Prohibition of, 14.
Alkali ammonium phosphate (New Patent), 79.
Alkaloid test for tannin, 188.
Alleged discovery of Stone Age man in Africa, 70.
Alloys of zirconium, 220.
Alumina sodium aluminate (Sodium sulphide), 47.
Aluminium paint to be used on new U.S. cruisers, 349.
American influence in Italian industry, 120.
America the land of gas, 51.
Ammonium ion, Influence *on* the quinhydrone electrode potential, 276.
Analyses of the cereal grains—oats, 413.
Analysis of photographic emulsion, 195.
Analysis of the first spark spectrum of sulphur, 57.
Apparatus and methods for the separation, etc., of the chemical constituents of petroleum, 294.
Application of chemistry in modern farming, 134.
Application of the interferometer to the goniometry of prisms, 140.
Architects and building corrosion by smoke and air, 74.
Arc spectrum in the region λ1600–λ2100, 317.
Arc spectrum of germanium, 365.
Artificial silk, 309.
Artificial sunlight and good health, 9.
Ash deposits in Saskatchewan, 281.
Askern coalite works, 387.
Atomic model for the chemist, 225.
Attractive forces as conditioned by propulsion, 338.
Aurora red line, 36.
Australia, Commonwealth of, Council for scientific research, 395.
Autoxidation boundary pressures, 97, 114.

BAEYER'S strain theory, The modification of, 164.
Baeyer's strain theory, The modification of, 164.
Band spectrum of lanthanum monoxide, 398.
Barcelona international exhibition, 167.
Beam given by dioptric apparatus, The, 415.
Beryllium in rocks, Determination of small quantities of, 123.
Bioluminescence, Physico-chemical studies on, 247.
Bismutotantalite, A new mineral from Uganda, 411.
Bleaching of rayon, 409.
Boric acid and borates, A new test for, 122.
Brain, Sir Arthur Keith on the, 85.
Britain's £80,000,000 smoke bill, 267.
British capital and trade in Argentina, 68.
British exports first quarter of 1929, 281.
British industries fair, 89.
British iron and steel output in 1928, 71.
Brittleness in arsenic copper, 202.
Bromine chloride, 58.

CADMIUM in Canada, 348i.
Calc-gneisses and cordierite sillimanite gneisses of Coimbatore, Madras Pres., 221.
Canada chemical industries, 41.

Canadian chemical production, Great advance in, 317.
Canadian Institute of Mining and Metallurgy, Annual meeting, 312.
Canadian iron and steel production, Increase in, 136.
Canadian lead and zinc, 87.
Canadian National Research Council, 314.
Canada's mining industry, 212, 231.
Capillary tube method for simultaneous determination of surface tension and density, 141.
Carbon monoxide in mines, Detection of, 169.
Catalysis, Study of by silver of the union of hydrogen and oxygen, 364.
Catalytic oxidation of naphthalene, 51.
Chemical elements, Transmutation of, 230.
Chemicals from tree stumps, 363.
Chemical industries in Canada, Progress of, 347.
Chemical plant and machinery, The maintenance of, 52.
Chemical research in Malaya, 67.
Chemical Society of Japan, Recent papers, 157.
Chemistry and the classics, 39.
Chemistry by an Ignorant Student, 72.
Chemistry of the three-carbon system, 59.
Chemists, Registration of, 53.
Chester Society of Natural History and Science, 359.
Chlorine in flour, 105.
Chromic acid (New Patent), 308.
Coal, iron and steel in various countries, 251.
Coal output under the five counties scheme, 137.
Coal, Selection of for gas producers, 236.
Coal, The magic of, 375.
Collection of Czechoslovak chemical communications, 157.
Collinsics of minerals, 184, 273, 369.
Collinsics of minerals (IX), 82.
Colloid chemistry, 61.
Combination of proteins, amino-acids, etc., with acids and alkalis, 106.
Comenius, The mediæval educationist, 131.
Commercial secretary in the U.S.A., Visit of, 170.
Competition of industrial designs (Royal Society of Arts), 109.
Conjugated compounds. Properties of, Part VIII, The additive formation of cyclohexanes, 172.
Constitution of the cadmium-rich alloys of the system cadmium-gold, 201.
Construction and calibration of a sensitive form of Pirani gauge for the measurement of high vacua, 141.
Contributions to the history of the Spectacle Makers' Company, 332.
Crater of Papandajan (Java), 45.
Cryoscopic method for the detection of added water in milk, 188.
Crystal forms of paraffin from shale oil, 210.
Crystal structure and magnetic properties in nickel, Relationship between, 339.
Crystal system of paraffin from shale oil, 198.
Czechoslovak glass industry, 200.
Czechoslovak chemical science, 72.
Chemical industries, 408.
409.
Chlorides of sulphur, The properties of the, 379.
Chromosome linkage in Oenothera, with special reference to some F. hybrids, 398.
Commonwealth of Australia, Council for Scientific and Industrial Research, 395.
Consumer credit, 406.
Critical temperature of freezing—living muscle, 397.

DARTMOOR granite, Unroofing of the, 253.
Deposition of radium and other alkaline earth metals at the dropping mercury cathode, 180, 175.
Detection of the presence of reducing radicals in the systematic analysis for the acids, 50.
Determination of CrO_4 in Paints, 214.
Determination of organic peroxides, 318.
Determination of unsaturated and aromatic hydrocarbons in light oils and motor spirit, 171.
Determination of zinc oxide in paints, 394.
Dialkylsulphones, A decomposition of, 28.
Diatomaceous earth in Canada, 103.
Dietetics, Professor Cowell on, 313.
Differential halogen absorption of oils and fats, 318.
Disodium phosphate (New Patent), 352.
Dissociation constants of organic acids, 331.
Double reflection level, 75.
Drude's equation, Validity of, 331.
Dull lustre viscose, 387.
Dyes, intermediates, 320.

EARTH'S atmosphere, Amount of ozone in, 88.
Effect of combined electric and magnetic fields on the helium spectrum, 57.
Einstein's new ideas, 83.
Electrical conductivity in strong electric fields, The change in, 139.
Electric current and energy transmission, 360.
Electric energy relations, 227.
Electric properties of thick cylindrical shells under internal pressure, 317.
Electrolytic polarisation complex cyanides (a) silver, (b) coppper, 172.
Electron, Is it a dummy?, 72
Energy, 229.
Enzymic synthesis of hydroxyethyl phosphoric acid, 59.
Equivalent resistance of air condensers at high frequences, Determination of, 75.
Estimation of sulphur in rubber, 294.
Etablissements Kuhlmann on Amsterdam Exchange, 56.
Ethyl alcohol (New Patent), 367.
Experimental studies on form and structure of sparks, 294.
Experiments concerning the counting of scintillations produced by alpha particles, 59.
Exposition of chemical industries (New York), 153.

FARADAY centenary, 141.

Faraday Medal awarded Italian, 109.
Fast dyeing and dyes, History of, 232, 264, 278.
Fast electrons, Scattering of, by atomic nuclei, 366.
Fatty acids and component glycerides of some New Zealand butters, 122.
F.B.I. new headquarters, 362.
Fermentation industries, 1928 Report on, 138.
Ferret, Oestrus and pseudo-pregnancy in the, 299.
Ferric oxide : sulphuric acid (New Patent), 208.
Ferrous hydroxide, The amphoterity of, 354.
Fertilisers from the air (British Science Guild lecture), 327.
Fire damp explosions research, 119.
Fire loss, Annual, 8.
Fire resistance of hollow load-bearing wall tile, 211.
Forests of Sweden, 87.
Formation of lactic acid in muscles in the frozen state, 397.
Functional problems attaching to convergence, Some, 410.
Function of the lens capsule in the accommodation of the eye, 74.
Furfural and diastase in heated honey, 254.
Fused quartz-pendulum rod for clocks, 75.

GALACTIC centre, Studies of the, 27.

Gaseous combustion in electric discharge, 365.
Gas industry, New phase in, 9.
Geodetic surveys, Progress of in Canada, 282.
Geology of district between Llanymawddwy and Llanuwchllyn, 45.
Germanium, Arc spectrum of, 365.
Germany trade treaty with South Africa, 69.
Glacial geology of Derbyshire Dome, 121.
Glaciation of Eastern Edenside, 379.
Glasses in hydrogen, Reduction of, 60.
Gold, Occurrence of at Hope's Nose, Torquay, 75.
Government laboratory, Singapore, 76.
Granulating sodium sulphide (New Patent), 95, 256.

HAGUE industrial property convention, 24.
Heat-production and recovery of crustacean nerve, The, 398.
Heat resisting steels with special reference to their application in the glass industry, 203.
Helicoidal classification of the elements, 372, 388.
Highways of to-morrow, 7.
History of the development of fast dyeing and dyes, 215, 232, 248, 264, 278.
History of medicine in India, 356,
History of the Yellowstone Cañon, 91.
Humber oil from coal scheme, 361.
Hydatid disease in Australia, 343.
Hydrochloric acid (New Patent), 335.
Hydrocyanic acid (New Patent), 287.
Hydrogen molecule and the electron, 116.
Hydrophenyl rhodamines and their sulphonic acids, 159.

IMPORTANCE of design and setting of large kettles used for refining, 219.
Improved form of electric resistance furnace, 219.

Inclusion in some apatites of some igneous rocks, 221.
Industrial reorganisation, 198.
Indian turpentine from *Pinus Longifolia Roxb.*, 106.
Indian turpentine from *Pinus longifolia Roxb.*, Part V, 59.
Industrial reorganisation, 198.
Industry and smoke abatement, 35.
Infra-red radiation of active nitrogen, 89.
Institute of Chemistry pass list, January, 1929, examination, 90.
International oil, chemical and colour trades exhibition, 199.
Investigation of the ranges of the long-range α-particles from thorium C and radium C, 139.
Investigations on the relations between the acidity and freezing point of milk, 189.
Investigation into the erosion of tank blocks, 235.
Identification of artificial silks and textile fibres, 291.
Iron in glass sands, Detection of, 60.

LAMINATED glass, Manufacture etc., of, *60.*
$L\alpha$ lines of silver, Spark satellites of, 122.
Lead and zinc in Canada, 102.
Light emission from the phosphorescent flames of ether, acetaldehyde, propaldehyde, and *n*-hexane, 412.
Liquid fuel, turpentine (New Patent), 384.
London *School of Hygiene, ? ?*
Loss of water and salts through the skin, 299.
Low grade fuel utilisation, 104.
Low temperature carbonisation developments, 118, 306.

MAGIC medicine of the Hottentots, The 403.
Magnetism, 161, 178.
Magnetism notes, 241.
Magnetostriction and the phenomena of the Curie point, *315.*
Manipulation in intensive drying, 412.
Man's brain Nature's masterpiece, 68.
Marine triassic fauna from Eastern Persia, 379.
Measurement of the viscosity of glass at high temperature by the rotating cylinder viscometer, The, 418.
Medicine in India, History of 356.
Mellon Institute, Industrial Fellowships of, 376.
Mellon Institute of Industrial Research, 339.
Mental diseases and the public, 329.
Metallurgists' conference in Germany, 343.
Metals, Sir Oliver Lodge on, 283.
Michelson-Morley experiment, 145.
Milk (frozen), Separation of by fractional melting, 321.
Mixtures of hydrocarbons of low boiling point, 127.
Mobility of ions in air, Dependence of on the relative humidity, 172.
Modern glass manufacture, 9.
Modern physics, Difficulties of, 4.
Modern swimming bath operation, 39.

NAPHTAL yellow, Reduction of, by menas of stannous chloride, 209.
Natural colour, Reproduction of, 193.
New era for British canals, 71.
New mining regulations for Western Canada, 155.
New thermopile for the measurement of nerve heat production, A, 398.
Nickel electrode, Potential of the, 248.
Nitrogen, hydrogen and ammonia (New Patent), 143.
Non-existence of isomerism among the dialkyltelluronium dihalides, 59.
Note on the Houghton-Hanson thermostat, A method of fine adjustment, 202.
Nova Scotia Institute of Science, 103.
intensities of the $L\alpha_1$, $L\alpha_2$, $L\alpha_3$ lines of silver, 122.

OCCURENCE of a mineral hitherto unrecognised in the phonolites of Dunedin, New Zealand, The, 411.
Optical rotatory power and rotatory dispersion, 331.
Organisms and crystals, 1.
Ortho-dichloro-4-Nitrobenzene, Some properties and transformations of, 117.
Outline of the history of medicine, 338.
Oxygen-Compound formation with acetaldehyde at low temperature, 264.

PAPER Pulp and cellulose from eucalypts by the sulphite process, 5, 22.
Partially-fused quartz-felspar rock and on glomero-granular texture, 411.
Patents, 1928 A record year of, 55.
Peace and war, The four component system in, 166.
Petrol from coal, 269.
Pharmaceutical Society's conversazione, 142.

Phosphoric acid (New Patent), 111.
195.
Photochemical equilibrium in nitrogen peroxide, 155.
Photo-elastic properties of glass, The, 414.
Photographic emulsion, The analysis of,
Photographic measurement of the relative
Photographs of Reflection Caustics, 75.
Physical constants, 229, 242, 257, 305.
Physical world, Nature of, 33.
Physicochemical studies on luminescence, 258.
Platinum, World's production of, 325.
Power generation developments, 103.
Potentiometric bromination of beta-naphthol-sulphonic acids, 293.
Precipitation of group II acids (The chloride group), in the presence of other acid radicals, 65.
Preparation of pure silicic acid solution by means of electrodialysis. I. Electrodialysis, 67.
Prepared milk patent, 315.
Pressure of gaseous mixtures, II, 58.
Pressure shifts in fine spectra of gases, 398.
Probability of Excitation by electron impact, 89.
Products of partial hydrogenation of some higher monoethylenic esters, 89.
Production of kojic acid from pentoses by *Aspergillus oryzæ*, 378.
Prospecting and the discovery of mines in South Africa, 210.
Pulverised fuel, 268.

QUANTUM theory of dispersion, 316.
Quicklime for use in distillation of ammonium from ammonium liquors obtained from coke and gas manufacture, 282.
Quinine in the blood, On the distribution of, 167.

RADIUM and other alkaline earth metals, Deposition of at the dropping mercury cathode, 195.
Radium discussed in Parliament, 105.
Reactions of certain olefines of high molecular weight with sulphuric acid, hydrochloric acid and the air, 292.
Recent developments in electric furnaces, 219.
Record Canadian coke production, 105.
Recovered or secondary tin, Importance of, 107, 123.
Red triangle cement organisation, 87.
Rees, Sir John, Memorial, 10.
Refrigeration in nature, 182.
Relation between the density and refractive index of silicate glasses, 222.
Relative intensities of stark components in hydrogen, 58.
Research fellowships at the Missouri School of Mines, 70.
Residual affinity and co-ordination, Researches on, 28.
Resistance of zinc to indentation, 220.
Rhodesia, Geology of part of North-Western, 271.
Royal Microscopical Society, New members of, 126.
Royal Society of Arts competition of industrial designs, 10.
Radio-active decay of, and the penetration of α-particles into a simplified one-dimensional nucleus, 365.
Rayon, 309.
Rayon statistics, International, 361.
Reciprocal contraction of antagonistic muscles in peripheral preparations—using flashiug neon lamp circuit for excitation of nerve, 397.
Recombination spectra of ions and electrons in caesium and helium, 325.
Relative configurations of *d*-β-Octanol and its dextro-rotatory halides. The interconversion of the optically-active octanols by a new method, 412.
Relativistic theory of an atom, 315.
Researches on vegetable assimilation and respiration, 300.
Royal Agricultural Society, 332.

SASKATCHEWAN, Mineral resources of, 25.
Scattering theory of the effect of the glare on the brightness difference threshold, The, 397.
Science of keeping fit, 168.
Selenium oxychloride and phenols, 29.
Sensitive form of urani gauge for the measurement of high vacua, 122.
Sewage and water analysis, 254.
Silver contents of specimens of ancient and mediaeval lead, 220.
Silver, Dissolution in water, 24[illegible].
Simple method of fitting a straight line to a series of observations, 316.
Single bands of the nitrogen molecule, 91.
Sir Arthur Keith compares the brain to a newspaper, 73.
Sixth annual competition of industrial designs, 412.
Sizing technique, Development of, 347.
Smokeless fuel, Authority behind, 25.
Smokeless fuel shortage, 84.

Soil surveys in Canada, 170.
Solution of plain and amalgamated zincs in electric batteries, 220.
Some South Australian algal limestone in process of formation, 253.
Some unsolved problems relating to the mobilities of gaseous ions, 172.
South African Association for the Advancement of Science, 253.
South Wales end moraine, 121.
Special properties of eutectics, 188.
Spectral absorption of certain monoazo dyes, The effect of position isomerism on the spectral absorption of methyl derivatives of benzeneazophenol, The, 401.
Spectrum of H_2, 90.
Stability of complex metallic salts, 171.
Starch and glucose, Aspects of the manufacture of, 260.
Stark-effect in a violet region of the secondary spectrum of helium, 58.
Statistical periodic table, 129.
Stellar atmosphere, Structure and opacity of a, 377.
Steam generation efficiency, 275.
Stop watches for science work, 186.
Studies of crystallisation of paraffin; crystal system of paraffin from shale oil), 198.
Study of the Thermal expansion of glass up to the softening temperature, A, 413.
Substituted diphenyl amines, New method for preparing, 106.
Sulphonic acids (New Patent), 101.
Sulphuric acid industry in Japan, 296.
Sulphuric acid (New Patent), 223.
Synthetic drugs, 307.
Synthetic drugs, 307.

TELESCOPIC systems of small magnitude, Axial abberrations of, 12.
Telescopic systems of small magnitude, Axial abberrations of, 12.
Tensorial form of Dirac's wave equations, 57.
Testing 200 varieties of Scottish coal, 188.
Testing of electro-deposits on aluminium, 118.
Thermal conductivity of solid and liquid sulphur, 58.
Thermal storage, Development in, 48.
Thermionic emission constant A, 57.
Tholeiite dykes of the North of England, 75.
Titanium sulphate, 415.
Trade in British Malay, 1928, 140.

ULTRA-VIOLET spectrum of magnesium hydride, 57.
United States trade and industry, 72.
University of London, University College, public lectures, 271.
U.S.A. Department of Agriculture, 363.

VACUUM distillation, Some experiments on, 139.
Vacuum distillation, Some experiments on, 139.
Viscose, Dull lustre, 387.
Vitamin researches in Japan, 131.

WATER softening, 289.

Watter, Swimming bath, 338.
Wave lengths and Zeeman effects in yttrium spectra, 40.
Western dolomites, The structure of the, 205.
Wholesale prices in February, 187.
Work-softening and a theory of inter-crystalline cohesion, 188.
World's biggest coal distillation plant for Scotland, 187.
World's largest distillation plant, 276.
Wreath on Sir Humphry Davy's tomb, 363.

X-RAY emission, soft, from various elements after oxidation, 364.
X-Ray investigation of the structure of naphthalene and anthracene, 365.

YOUNG, James, Memorial, 362.

Yttrium, Yt. I and Yt. II) Analysis of the arc and spark spectra of, 375.

ZEEMAN effect for the arc spectrum of gold, The, 398.

AUTHORS.

Andrew, A. L. :
Cryoscopic Method for Detection of Added Water to Milk, 189.
Atkinson, R. d'E. :
Probability of Excitation by Electron Impact, 89.
Ayling, E. E., M.Sc. :
Modification of Baeyer's Strain Theory, 104.

Baker, J. L., and Hulton, H. F. E.:
Manipulation in Intensive Drying, 412.
Bannister, F. A.:
Silicate Glasses, Relation between the Density and Refractive Index of, 222.
Barker, H. B.:
Analyses of the Cereal Grains, 413.
Barrett, S., and Stein, C. P.:
Bromine Chloride, 58.
Benjamin, L. R., Somerville, J. L., B.Sc.:
Paper Pulp and Cellulose, 5, 23.
Bhattacharyya, D. K.:
Blazey, Clement, M.Sc.:
Brittleness of Arsenic Copper, 202.
First Spark Spectrum of Sulphur, 57.
Boys, Prof. C. Vernon:
A Fused Quartz Pendulum Rod for Clocks, 75.
Bourdillon, R. B., and Others:
Absorption of Spectrum Vitamin D, 300.
Bowmaker, E. J. C., B.Sc., and Cauwood, J. D., M.Sc.:
Selection of Coal for Gas Consumers, 236.
Bowman, A.:
Attractive Forces as Conditioned by Propulsion, 338.
Briscoe, Grace, and Leyshon, Winifred:
Reciprocal Contraction of Antagonistic Muscles in Peripheral Preparations—Using Flashing Neon Lamp Circuit for Excitation of Nerve, 397.
Braddock-Rogers, K.
Action of Air-Carbon Tetrachloride Vapour Mixtures on Certain Natural and Artificial Sulphides, Selenides and Tellurides, 147.
Brett, C. W.:
Maintenance of Chemical Plant and Machinery, 52.
Brode, Wallace R.:
The Spectral Absorption of Certain Monoazo Dyes.—The Effect of Position Isomerism on the Spectral Absorption of Methyl Derivatives of Benzeneazophenol, 401.
Brookes, A. C.:
Government Laboratory in Singapore, 76.
Brook, G. B., F.I.C.:
Testing of Electro-Deposits on Aluminium, 188.
Bryson, F.F.S., M.A., B.Sc.:
The Erosion of Tank Blocks, 235.
Burch, C. R.:
Some Experiments in Vacuum Distillation, 189.
Burgess, S. G., and Hunter, H.:
Investigations on the Dependence of Rotatory Power on Chemical Constitution, 881.

Campbell, D. F., M.A.:
Electric Furnace, Recent Developments in, 219.
Carr, Francis H., C.B.E.:
Development of British Chemical Manufactures, 290, 307.
Challenger, F., Klein, L., Walker, T. K.:
The Production of Kojic Acid from Pentoses by *Aspergillus oryzæ*, 378.
Chapman, A. W.:
Substituted Di-phenylamines, New Method for Preparing, 106.
Chapman, D. L., F.R.S., and Hall, W. K.:
A Study of the Catalysis by Silver of the Union of Hydrogen and Oxygen, 364.
Chariton, J., and Lea, C. A.:
Counting of Scintillations Produced by Alpha Particles, 59.
Charlesworth, Prof. John Kaye, D.Sc., Ph.D.:
South Wales End Moraine, 121.
Collins, Hawksworth, B.A. (Camb.):
The Collinsics of Minerals, IX., 82.
The Collinsics of Minerals, X., 184, 273, 366.
Cooper, D. le B., M.Sc.:
Oxygen-Compound Formation, 264.
Court, T. H., and Von Rohr, Prof. Moritz:
Spectacle Makers' Company, 332.
Cowell, Prof. S. J.:
Dietetics, 313.
Cronshaw, Dr. H. B., B.A., Ph.D.:
World's Largest Coal Distillation Plant, 276.
Crow, W. B., D.Sc., Ph.D.:
Organisms and Crystals, 1.
Croxford, J. W.:
Differential Halogen Absorption of Oils and Fats, 818.
Curtman, L. J., and Plechner, W. W.:
Detection of the Reducing Radicals in the Systematic Analysis for the Acids, 50.
Curtman, Louis J., and Plechner, Walter W.:
Precipitation of Group II Acids (The Chloride Group), in the Presence of Other Acid Radicles, 65.

Darwin, C. G., F.R.S.:
Collision Problem in Wave Mechanics, 315.
Davis, Edward J. Ch.E.:
Determination of CrO_4 in Paints, 214.
Davis, Edward J., Ch.E., Research:
Determination of Zinc Oxide in Paints, 394.

Davies, L. P. :
The Soft X-ray Emission from Various Elements after Oxidation, 364.
Day, H. D. :
Enzymic Synthesis of Hydroxyethyl-Phosphoric Acid, 59.
Dickens, A. H., Hugh, W. E., and Kon, G. A. R. :
Chemistry of the Three Carbon System. Part XX, 59.
Dobson, G. M. B., F.R.S., Harrison, D. N., and Lawrence, J. :
Measurements of the Amount of Ozone in the Earth's Atmosphere, 88.
Dodd, A. Scott, B.Sc. :
A New Test for Boric Acid and Borates, 122.
Douglas, James Archibald, M.A., D.Sc., F.G.S. :
A Marine Triassic Fauna from Eastern Persia, 379.
Downing, A. C., and Hill, A. V., F.R.S. :
A New *Thermopile for the Measurement* of Nerve Heat Production, 398.
Drew, H. D. K. :
Non-Existence of Isomerism among the *Dialkyltelluronium Dihalides*, 59.
Druce, Dr. J. G. F., M.Sc .(Lond.), F.I.C. :
Reduction of Naphthol Yellow by Means of Stannous Chloride, 209.
Durrant, P. J., M.A., Ph.D. :
Constitution of the Cadmium-Rich Alloys of the System Cadmium-Gold, 201.
Houghton-Hanson Thermostat, Method of Fine Adjustment, 202.

Emeleus, H. G. :
The Light Emission from the Phosphorescent Flames of Ether, Acetaldehyde, Propaldehde and *n*-Hexane, 412.

Farmer, E. H., and Warren, F. L. :
The Additive Formation of Cyclohexenes, 172.
Fear, Christine Mary, B.Sc. :
Alkaloid Test for Tannin, 188.
Ferguson, Allan, M.A., D.Sc. :
Capillary Tube Method for Simultaneous Determination of Surface Tension, 141.
Finch, G. I., and Hodge, D. L. :
Gaseous Combustion in Electric Discharge, 365.
Fincham, E. F. :
Function of the Lens Capsule in the Accommodation of the Eye, 74.
Foster, J. S., and Chalk, M. L. :
Stark Components of Hydrogen, Relative Intensities of, 58.
Foster, J. S. :
Effect of Combined Electric *Fields* on the Helium Spectrum, 57.
Fowler, R. H., F.R.S. :
Thermionic Emission Constant A, 57.
Fowler, R. H., F.R.S., and Kapitaza, P. :
Magnetostriction and the Phenomena of the Curve Point, 315.
Fowler, R. H., F.R.S., and Walson, A. H. :
A Detailed Study of the Radioactive Decay of, and the Penetratiou of α-Particles into a Simplified One-Dimensional Nucleus, 365.
Freeman, L. J. :
Further Investigations of the Spectrum of Ionised Nitrogen, 366.
Freeth, Dr. F. A. :
The Four Component Systems in Peace and War, 166.
Friend, J. Newton, D.Sc., Ph.D., F.I.C. :
Resistance of Zinc and Indentation, 210.
Solution of Plain and Amalgamated Zincs *in Electric Batteries*, 220.
Ancient and Mediaeval Lead, Silver Contents of Specimens of, 220.

Ganti, R. G., and Spear, F. G. :
Effect of Gamma Irradiation on Cell Division in Tissue Culture *in Vitro*, 500.
Gaunt, J. A. :
Relativistic Theory of an Atom with Many Electrons, 315.
Gayler, Marie, L. V., D.Sc. :
Age-Hardening of Some Aluminium Alloys, 201.
Gibbs, O. S., M.B., Ch.B. :
On the Distribution of Quinine in the Blood, 167.
Gibby, C. W., Tanner, C. C., and Masson, I. :
Pressure of Gaseous Mixtures, II, 58.
Gibson, G. S., and Simonsen, J. L. :
Indian Turpentine from *Longifolia Roxb.*, 106.
Glasstone, S. :
Studies in Electrolytic Polarisation Complex Cyanides (a) Silver, (b) Copper, 172.
Gordon, Mrs. M. M. Ogilvie :
Structure of the Western Dolomites, 204.
Griffiths, Ezer, D.Sc., F.R.S., and Awbery, B.A., B.Sc. :
The Dependence of the Mobility of Ions in Air on the Relative Humidity, 173.
Groves, Dr. A. W., and Mourant, A. E. :
Inclusions in the Apatites of Some Igneous Rocks, 221.
Unroofing of the Dartmoor Granite, 258.

Haldane, J. S., F.R.S., Hancock, W., and Whitehouse, J. G. R. :
Loss of Water and Salts Through the Skin, 299.
Hampton, W. M., Ph.D., B.Sc., F.Inst.P., A.I.C. :
The Beam Given by Dioptric Apparatus, 415.
Hargreaves, F., F.I.C. :
Work Softening and a Theory of Inter-Crystalline Cohesion, 188.
Haring, N. M., and Bosche, E. G. Vanden :
Potential of the Nickel Electrode, 248.
Harris, F. C., M.Sc. :
The Photo-Elastic Properties of Glass, 414.
Harris, L. J. :
Combination of Proteins, Amino-Acids, with Acids and Alkalis, 106.
Hawkes, Dr. L. :
On a Partially-Fused Quartz-Felspar Rock and on Glomero-Granular Texture, 411
Hazlerigg, Sir A. :
Humber Oil from Coal Scheme, 360.
Heyrovsky, J., and Berezicky, S. :
The Deposition of Radium and Other Alkaline Earth Metals at the Dropping Mercury Cathode, 180, 195.
Hilditch, T. P., and Vidyarthi, N. L. :
Products of Partial Hydrogenation of Some Higher Monoethylenic Esters, 89.
Hilditch, P., D.Sc., F.I.C. :
Fatty Acids and Component Glycerides of New Zealand Butter, 122.
Holmes, Prof. A. :
Tholeiite Dykes of the North of England, 75.
Houssa, A. J. H., Kenyon, J., and Phillips, H. :
The Relative Configurations of d-β-Octanol and its Dextro-Rotatory Halides. The Interconversion of the Optically Active-Octanols by a New Method, 412.
Hughes, Robert Murray, F.G.S. :
Geology of Part of North Western Rhodesia, 270.

Ingberg, S. H., and Foster, H. D. :
Fire Resistance of Hollow Load-Bearing Wall Tile, 211.
Ingold, C. K., and Vass, C. C. N. :
Influence of Poles and Polar Linkings, 28.
Iyer, L. A. Narayana :
Calc-gneisses of Coimbatore, Madras Pres., 221.

Janet, Charles :
The Helicoidal Classification of the Elements, 372, 388.
Jarvie, J. Gibson :
Consumer Credit, 406.
Jevons, W. D.Sc., F.Inst.P. :
The Band Spectrum of Lanthanum Monoxide, 398.
Johnson, J. W. Haigh, M.Sc., F.I.C. :
Methods of Sewage and Water Analyses, 254.
Johnston-Saint, Captain P., M.A. (Cantab), F.R.S. :
History of Medicine in India, 333, 339.
History of Medicine in India, 356.
Jones, Prof. Owen Thomas, M.A., D.Sc. :
History of the Yellowstone Cañon, 91.
Jorissen, Prof. W. P. :
Autoxidation Boundary Pressures, especially that of Phosphorus, 97, 114.
Jowett, Albert, D.Sc., and Charlesworth, Prof. John Kaye :
Glacial Geology of the Derbyshire Dome and the Western Slopes of the Southern Pennines, 121.
Kapitza, P. :
Change in Electrical Conductivity in Strong Electric Fields, 189.
Kanda, Sakyo :
Physico-Chemical Studies on Bioluminescence, 247, 258.
Kaye, G. W. C., and Higgins, W. F. :
Thermal Conductivity of Liquid and Solid Sulphur, 58.
Keeble, Sir Frederick, C.B.E., F.R.S. :
Fertilisers from the Air, 327.
Keith, Sir Arthur :
The Brains of Geniuses, 85.
Kichlu, P. K., and Acharya, D. P. :
Infra-Red Radiations of Active Nitrogen, 89.
Kidd, Franklin, M.A., D.Sc. :
Refrigeration in Nature, 132.
Krepelka, H., and Toul, F. :
Dissolution of Silver in Water, 243.
Kusama, Tokishige :
Catalytic Oxidation of Naphthalene, 51.

Laidler, P. W., L.R.C.S. & P., D.P.H., F.S.A. (Scot.) :
The Magic Medicine of the Hottentots, 408.
Lampitt, L. H., D.Sc., F.I.C. :
Furfural and Diastase in Heated Honey, 254.
Lancaster, Harry C. :
Importance of Design and Setting of Large Kettles Used for Refining, 219.

Langworthy, Florence :
Atomic Medel for the Chemist, 225.
Lees, Charles H., D.Sc., F.R.S. :
Free Periods of a Composite Column or Composite Stretched Wire, 141.
Lesslie, M. S., and Turner, E. E. :
The Isomerism of 2-Pheuylnaphthylene-1 : 3-Diamine, 379.
Littleton, W. R. :
Laminated Glass Manufacture, 60.
Lloyd, Prof. J. E. :
The Welsh Chronicles, 10.
Lodge, Sir Oliver :
Artificial Sunlight and Good Health, 9.
Energy, 229.
Loring, F. H. :
The Absolute Zero of Temperature, 18, 81.
Einstein's New Ideas, 83.
Electric Current and Energy Transmission, 360.
Hydrocarbon Molecule and Electron, 116.
Interesting Astrophysical Papers, 145.
Magnetism, 161, 178.
Magnetism Notes, 241.
Physical Constants, 242, 257, 305.
Professor Eddington and the Wonder World, 33.
Lowry, T. M., and Jessop, G. :
The Properties of the Chlorides of Sulphur, 379.
Lowry, T. M. :
Dude's Equation, Validity of, 331.

Macdonald, J. K. L. :
Stark Effect in a Violet Region of the Secondary Spectrum of Helium, 58.
Mackay, J. G. :
Estimation of Sulphur in Rubber, 294.
Mann, F. G. :
The Stability of Complex Metallic Salts, 171.
Manning, A. B. :
Determination of Unsaturated and Aromatic Hydrocarbons in Light Oils and Motor Spirits, 171.
Marshall, Dr. F. H. A., F.R.S., and Hammond, J. :
Oestrus and Pseudo Pregnancy in the Ferret, 299.
Marshall, Dr. P. :
The Occurrence of a Mineral Hitherto Unrecognised in the Phonolites of Dunedin, New Zealand, 411.
Mathey, Dr. C. A. :
Crater of Papandajan (Java), 45.
Matsumaye, Shiro :
The Analysis of Photographic Emulsion, 195.
Matthews, Dr. M. A. :
The Magic of Coal, 375.
Mawson, Sir Douglas, D.Sc., F.R.S. :
South Australian Algal Limestone in Process of Formation, 253.
McIntosh, D., M.A., D.Sc. :
Compounds of Hydrogen Chloride with Ether and Acetone, 214.
McLachlan, J. A., M.Sc. :
Starch and Glucose, Manufacture of, 260.
McMaster, L., and Magill, A. C. :
Some Properties and Transformations of Ortho-Dichloro-4-Nitrobenzene, 117.
Meggers, William, and Russell, H. N. :
An Analysis of the Trc and Spark Spectra of Yttrium (Yt I and Yt II), 375.
Meggers, William :
Wave Lengths and Zeeman Effects in Yttrium Spectra, 4.
Messer, William Earl :
Reactions of Certain Olefines of High Molecular Weight with Sulphuric Acid, *etc., and the Air,* 292.
Milne, E. A., F.R.S. :
Structure and Opacity of a Stellar Atmosphere, 377.
Mohler, F. L., and Boeckner, C. :
Recombination Spectra of Ions and Electrons in Caesium and Helium, 324.
Moran, T. :
Critical Temperature of Freezing—Living Muscle, 397.
Morell, R. S., M.A., Ph.D. :
Determination of Organic Peroxides, 318.
Morgan, G. T., and Castell, R. A. S. :
Residual Affinity, 28.
Morgan, G. T. :
Selenium Oxychloride and Phenols, 29.
Morton, James :
Fast Dyeing and Dyes, History and Development of, 215, 232, 248, 264, 278,
Mott, N. F. :
Scattering of Fast Electrons by Atomic Nuclei, 366.
Mourashinsky, B. E., and *Savostianoff,* Miss M. :
Telescopic Systems, 12.

Nimmo, I. S., and Feather, N. :
Investigation of the Ranges of the Long Range α-Particles from Thorium C and Radium C, 189.
Norrish, R. G. W. :
Photochemical Equilibrium in Nitrogen Peroxide. Part II. Dependence of Quantum Efficiency on Wave Length, 155.

Oka, Shumpei :
Preparation of Pure Silica Acid Solution by means of Electrodialysis. I. Electrodialysis, 67.

Parker, A. J., and Speackman, L. S. :
Relations Between the Acidity and Freezing Point of Milk, 189.
Pearse, R. W. B. :
Ultra-Violet Spectrum of Magnesium Hydride, 57.
Perfect, D. S., M.A. :
Application of the Interferometer to the Goniometry of Prisms, 140.
Perfect, D. S., M.A., D.Phil. :
Double Reflection Level, 75.
Phelps, H. J., and Peters, R. A. :
Influence of Hydrogen Ion Contraction on the Absorption of Weak Electrolytes by Pure Charcoals, 316.
Pretty, W. E., A.R.C.S., D.I.C., B.Sc. :
The Pressure Shifts in Fine Spectra of Gases, 398.
Proctor, R. F., B.Sc., A.M.I.E.E., and Douglas, R. W. :
The Measurement of the Viscosity of Glass at High Temperature by the Rotating Cylinder Viscometer, 413.
Pugh, Prof. William John, O.B.E., D.Sc. :
Geology of the District Between Llanymawddwy and Llanuwchllyn (Merionethshire), 45.

Randall, J. T., and Leeds, R. E. :
Detection of Iron in Glass Sands, Reduction of Glasses in Hydrogen, 60.
Rao, K. R., D.Sc. :
Spectra of Trebly Ionised Thalium, 317.
Richardson, J. B. :
Recovered or Secondary Tin, Importance of, 107, 123.
Richardson, O. W., and Davidson, P. M. :
Singlet Bands of the Hydrogen Molecule, 90.
Richardson, O. W., F.R.S., and Das, K. :
The Spectrum of H_2, 90.
Robertson, J. M. :
An X-ray Investigation of the Structure of Naphthalene and Anthracene, 365.
Rogers-Braddock, K. :
The Action of Air Carbon Tetrachloride Vapour Mixtures on Several Sulphides, Sulpharsenites, and Sulphantimonites, 385.
Rosenhain, W., D.Sc., F.R.S. :
Electric Resistance Furnace, Improved Form of, 219.
Ross, I. Clunies, D.V.Sc. :
Hydatid Diseases in Australia, 343.
Russell, A. :
Occurrence of Gold at Hope's Nose, Torquay, 75.

Saldan, Prof. P. :
Special Properties of Eutectics and Eutectic Alloys in Binary Metallic Systems, 188.
Sarjant, R. J., M.Sc. :
Heat-Resisting Steels with Special Reference to the Glass Industry, 203.
Saxon, Robert, B.Sc., F.C.S. (Lond.), M.S.Chem.I., M.Amer.C.S. :
Reproduction of Natural Colour, 193.
Schrager, B. :
Polarographic Studies with the Dropping Mercury Cathode, 354.
Segrave, H. O. D. :
Highways of To-morrow, 7.
Selwyn, E. W. H., B.Sc. :
Arc Spectra in the Region λ1600-λ2100, 317.
Shapley, Harlow :
Studies of the Galactic Centre, 27.
Shearer, A. B. :
Rayon—Artificial Silk, 309.
Sheffield, F. M. L. :
Chromosome Linkage in Oenothera, with Special Reference to some F. Hybrids, 398.
Sherrington, Sir Charles, O.M., F.R.S. :
Some Functional Problems Attaching to Convergence, 410.
Shikata, Masuzo, and Tachi, Isamu :
Influence of the Ammonium Ion on the Quin-Hydrone Potential, 276.
Sizoo, Dr. G. J. :
Crystal Structure and Magnetic Properties in Nickel, 339.
Smith, E. C. :
The Formation of Lactic Acid in Muscles in the Frozen State, 397.
Smith, T., M.A. :
Photographs of Reflection Caustics, 75.
Skew Pencils, 12.
Stanley, L. F. : B.Sc. :
Construction and Calibration of a Sensitive Form of Piranni Gauge, 141.
Sensitive Form of Piranni Gauge, 122.
Stephenson, H. H. :
A Statistical Periodic Table, 129.

Stiles, W. S. :
The Scattering Theory of the Effect of Glare on the Brightness Difference Threshold, 397.
Student, An Ignorant :
On Chemistry, 73.
Sumptnor, W. E., D.Sc., M.I.E.E. :
Heaviside's Functional Differentiator, 316.
Sutton, G. W., B.Sc. :
Method for Determination of Equivalent Resistance of Air Condensers at High Frequencies, 75.
Sykes, C., M.Ec., Ph.D. :
Alloys of Zirconium, 220.
Symons, A. S. M., A.R.C.S., D.I.C., B.Sc., and Daley,. J., A.R.C.S., D.I.C. :
The Zeeman Effect for the Arc Spectrum of Gold, 398.

Tanaka, Y., Kobayashi, R., and Ohno, S. :
Studies on Crystallisation of Paraffin, 198, 210.
Tombrock, Dr. W. :
The Difficulties of Modern Physics, 4.
Trevor, Tudor G. :
South Africa, Prospecting and Discovery of Mines in, 210.
Trotter, Frederick Murray, M.Sc., F.G.S. :
The Glaciation, the Alston Block, and the Carlisle Plain, 379.
Turner, Prof. W. E. S., and Winks, F., M.Sc.Tech. :
A Study of the Thermal Expansion of Glass up to the Softening Temperature, 413.
Tyndall, Prof. A. M., D.Sc. :
Some Unsolved Problems Relating to the Mobility of Gaseous Ions, 173.

Vincent, J. H., M.A., D.Sc. :
Experiments on Magnetostrictive Oscillators at Radio Frequencies, 350.
Vogel, A. I. :
Dissociation of Constants of Organic Acids, 331.

Webster, H. C., M.Sc. :
Photographic Measurement of the Relative Insensities of $L\alpha_1$, $L\alpha_2$, $L\alpha_3$ Lines of Silver, 122.
Wedgewood, G. A. :
Elastic Properties of Thick Cylindrical Shells Under Internal Pressure, 317.
Well-Known Engineer :
Modern Swimming Bath Operation, 39.
Low Temperature Developments, 118, 306.
Steam Generation Efficiency, 275.
Water Softening, 289.
Swimming Bath Water, 338.
Winter, Viktor V. :
Frozen Milk, Separation of by Fractional Melting, 321.
Wood, Alexander, M.A. :
Waves, 11.
Wright ,W. D., A.R.C.S. :
Re-determination of the Trichromatic Coefficients of the Spectral Colours, 204.
Yamamoto, Ryazo :
Experimental Studies on Form and Structure of Sparks, 294.

SOCIETIES.

Chemical Society, 28, 59, 106, 155, 171, 220, 331, 378, 380, 412.
Chemical Society of Japan, 91, 157, 333, 380, 414.
Faraday Society, 141.
Geological Society, 14, 45, 91, 121, 204, 253, 270, 379, 399.
Institute of Chemistry, 76, 172, 380.
Institute of Metals, 94, 187, 201, 219, 382.
Institution of Civil Engineers, 270.
Institution of Mining and Metallurgy, 60, 107, 123.
London School of Hygiene, 125.
Mineralogical Society, 75, 221, 411.
Optical Society, 12, 60, 74, 140, 205, 379, 415.
Physical Society, 75, 122, 141, 173, 316, 350, 398.
Royal Institute of British Architects, 126.
Royal Microscopical Society, 125, 308.
Royal Society, 57, 106, 139, 299, 315, 364, 377, 397, 399, 410.
Royal Society of Arts, 11, 18, 47, 79, 88, 92, 95, 109, 143, 280, 399, 412.
Royal Agricultural Society, 18, 189, 382.
Royal Institute of British Architects, 4, 29, 47.
Royal Institute of Public Health, 191.
Royal Institution, 11, 79, 95, 107, 159, 301, 317, 381.
Royal Society of British Sculptors, 8.

Royal Society of Edinburgh, 189.
Society of Glass Technology, 14, 60, 189, 203, 235, 284, 413.
Society of Public Analysts, 79, 174, 188, 254, 318.

CORRESPONDENCE.

A Prepared Milk Patent. By Viktor V. Winter, 315.
Carbon Monoxide Danger. By A. W. Cope, 30.
Fuel Reform. By W. A. Bristow, 284.
The Eddington Interstellar Cloud. By Florence Langworthy, 298.
The Rise in Price of Petrol. By W. A. Bristow, 190.

NOTICES OF BOOKS.

Abderhalden's Handbuch der Biologischen Arbeitsmethoden, 237.
Abderhalden's Handbuch der Biologischen Arbeitsmethoden, 381.
A Class Book of Physical Chemistry, 78.
A Comprehensive Treatise on Organic and Theoretical Chemistry, 126.
A Concise Summary of Elementary Organic Chemistry, 207.
A New School Chemistry, 318.
Anorganische und Organische Entfarbungsmittel, 367.
A Pocket Book for Chemists, 255.
Applied Chemistry, 158.
A Reference Book of Inorganic Chemistry, 318.
Biochemistry of Amino Acids, 255.
Blonde or Brunette, 381.
British Journal Photographic Almanack, 94.
Can We Trade with Russia, 301.
Catalytic Processes in Applied Chemistry, 110.
Chemisches Fachwörterbuch (Deutsch-Englisch-Franzosich), 157.
Chemists' Year Book, 1929, 398.
Collected Scientific Papers of James Waterston, 77.
Colloid Chemistry, Theoretical and Applied, 61.
Die Adsorption, 93.
Die Künstlichen Harze, 301.
Die Spezielle Relativitatstheorie Einstein's und die Logik, 46.
Electrostatik in der Biochemie, 350.
Elektrizitat und Eiweisse, 302.
Foundations of the Theory of Dilute Solutions, 350.
Handbook of Chemistry and Physics, 236.
Hydro Extractors, 319.
Industrial Carbon, 222.
Institut International de Chemie Solway, 222.
Origin and Growth of Chemical Science, 62.
Physikalische Chemie der Silikate, 366.
Practical Chemistry for Matriculation, 350.
Professor Eddington on the Wonder World, 33.
Pyrolysis of Carbon Compounds, 366.
Quantentheorie und Chemie, 15.
Report of the Benzole Research Committee, 382.
School Books, 237.
Technik der Emulsionen, 126.
The American Prohibition of Alcoholic Beverages, 14.
The Industrial Development of Searles
The Industrial Production of Gases, 286.
Lake Brines, 302.
Text Book of Inorganic Chemistry, 61.
Textilchemische Erfindunger, 93.
Volumetric Analysis, 93.
Year Book of the Czechoslovak Republic, 206.

NEW PATENTS.

Acetic Acid, 175.
Acetic Anhydride, 64.
Alkali Ammonium Phosphates, 79.
Alumina Sodium Aluminate, 47.
Chemical Processes; Furnaces, 399.
Chromic Acid, 303.
Disodium Phosphate, 350.
Dyes, 159.
Dyes, Intermediates, 320.
Ethyl Alcohol, 367.
Ferric Oxide : Sulphuric Acid, 208.
Granulating Sodium Sulphide, 95.
Granulating Sodium Sulphide, 256.
Hydrochloric Acid, 335.
Hydrocyanic Acid, 287.
Liquid Fuel Turpentine, 384.
Nitrogen, Hydrogen and Ammonia, 143.
Phosphoric Acid, 111.
Separating Mixtures of Hydrocarbons of Low Boiling Points, 127.
Sulphonic Acid, 191.
Sulphuric Acid, 223.
Titanium Sulphate, 415.

Trade Marks, 16, 32, 47, 64, 80, 111, 128, [illegible] 160, 176, 208, 224, 256, 288, 304, 320, [illegible] 368, 384, 400, 416.